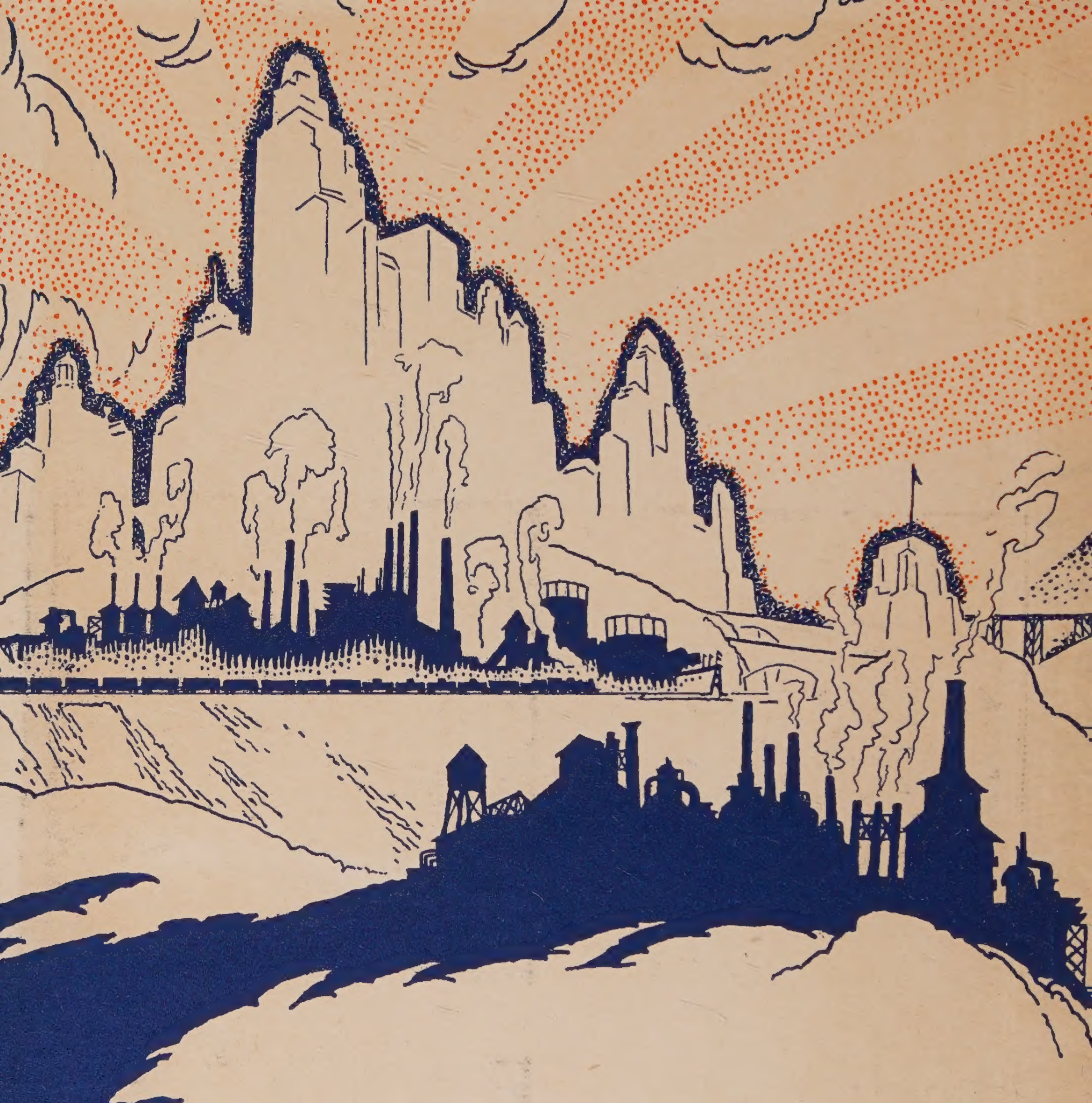
HISTORIC RAILROADS

RUPERT SARGENT HOLLAND



To Chad - from Aunt Margaret.

HISTORIC RAILROADS

"RAILROADS WILL BECOME THE GREAT HIGHWAY FOR THE KING AND ALL HIS SUBJECTS."

—*George Stephenson.*

Uniform with this volume

HISTORIC

SHIPS

by

Rupert Sargent Holland

THE *General* COVERED NINE MILES IN NINE MINUTES

HISTORIC RAILROADS

by

RUPERT SARGENT HOLLAND

Illustrated by MANNING deV LEE

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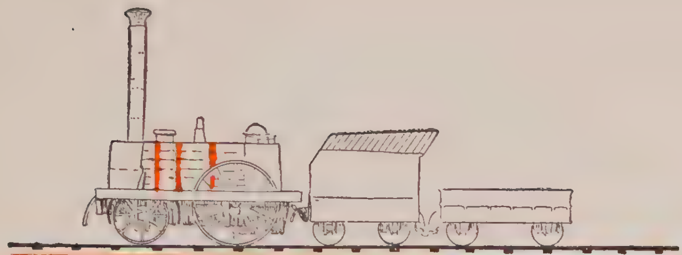
MANUFACTURED
IN THE U. S. A.

To
Durant L. Macrae

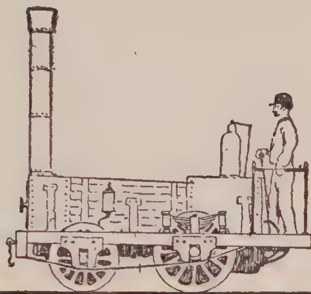


PREFACE

The history of railroads, unlike that of ships, is largely a story of the last hundred years. One century has seen the building of the first railways and the development of tracks and trains that encircle the globe. In this volume the author has attempted to relate the history of the steam locomotive in England and North America and to describe some of the most remarkable railroads in other parts of the world. He wishes to make special acknowledgment of thanks to the authors of the following books: Coaching, with Anecdotes of the Road, by Lord William Pitt Lennox; England in the Eighteenth Century, by William Connor Sydney; The American in England, by Robert E. Spiller; Life of George Stephenson, by Samuel Smiles; Wonders and Curiosities of the Railway, by William Sloane Kennedy; The Marvels of Railways, by Archibald Williams; Victories of the Engineer, by Archibald Williams; The Boys' Book of Rail-

roads, by Irving Crump; Stage Coach and Tavern Days, by Alice Morse Earle; Building the Pacific Railway, by Edwin L. Sabin; The Story of the Western Railroads, by Robert Edgar Riegel; Brave Deeds of Union Soldiers, by Samuel Scoville, Jr.; When Railroads were New, by Charles Frederick Carter; Railways of the World, by Fred A. Talbot; Chile, by L. E. Elliott; South America, by James Bryce; All the Russias, by Henry Norman; Trains, Tracks and Travel, by T. W. Van Metre; History of First Locomotives in America, by William H. Brown.

The author also wishes to express his thanks to the Director of the Science Museum of South Kensington, London, for permission to reprint the picture of a locomotive of the Killingworth class, and to the Union Pacific, and the Canadian National Railways for their courtesy in furnishing certain photographs reproduced in this book.



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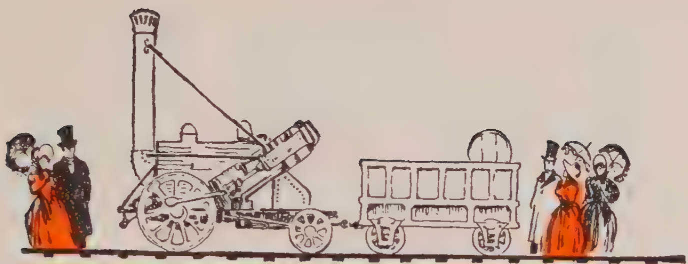


LIST *of* ILLUSTRATIONS

PART ONE

ENGLAND

1

COACHING DAYS AND WAYS

§ I

THE STAGECOACH

ROGER BACON, the famous Franciscan friar who flourished during the reign of Henry III of England, is said to have predicted that ships would some day move without sails and carriages without horses, but his prophecy was doubtless laughed at and set down as another joke of a strange fellow who dabbled in necromancy. Ships would not move without sails or oars nor carriages without horses. Carriages, moreover, were not always easily moved even with horses, and there were many great ladies in the time of Queen Elizabeth who preferred, as did the queen herself, to travel on horseback, either single, on their palfreys, or double, behind a gentleman, on a pillion, rather than to be jolted and jounced over rough roads in one of the new-fangled coaches imported from the continent.

Queen Elizabeth, however, although she did prefer

to ride behind her Lord Chancellor or one of her chamberlains, presently adopted a coach drawn by two horses for some of her longer journeys, and the royal example was copied by some of the richer noblemen; but not until much later did the use of coaches become at all general.

In the reign of Charles II public coaches carried passengers for hire between important cities, and in 1669 an equipage, described as the "flying coach," began a regular service between Oxford and London and accomplished the journey to the wonder of travellers between sunrise and sunset. Flying coaches were soon running three times a week from London to all the chief towns. In summer the ordinary day's journey was about fifty miles, and in winter, when the roads were muddy or slippery with ice, the day's run was about thirty miles. The Chester coach, the York coach, and the Exeter coach usually reached London in four days in fine weather, but in stormy seasons took six days. The fare averaged two-pence half-penny a mile in summer and more in winter. Six passengers could be carried and they were all seated inside the coach, since there were so many accidents that it was considered dangerous to ride upon the roof.

These flying coaches, which made it possible for people who did not own carriages to travel about the country, were no sooner established than they became the target for loud-voiced criticism. It was said the noble art of horsemanship would languish and fine

saddle-horses disappear, that saddlers would be driven out of business, that the Thames would no longer be the chief thoroughfare to London, that many inns where mounted travellers had been accustomed to stop would be deserted, that the coaches were too hot in summer and too cold in winter, that they frequently arrived at their destination too late for the passengers to get supper and started too early to procure breakfast. All sorts of efforts were made to have travellers return to the old customs of journeying on horseback and by water; but in spite of their critics coaches kept on the road.

By the eighteenth century the flying coach had become a stagecoach, and was the regular means of travel throughout England and Scotland. Advertisements were posted in all public places, proclamations such as this, describing the coach between London and Brighthelmstone (later called Brighton):

"Lewes and Brighthelmstone—new machine to hold four persons, by Charley, sets out by the 'George Inn,' in the Haymarket, St. James's at six o'clock in the morning, every Monday, Wednesday, and Friday, in one day to the 'Star' at Lewes, and the 'Old Ship' at Brighthelmstone, and returns from there every Tuesday, Thursday, and Saturday. Inside passengers to Lewes to pay thirteen shillings; to Brighthelmstone, sixteen shillings. To be allowed fourteen pounds weight of baggage, all above to pay one penny per pound."

The stagecoach, or the diligence, as it was often called, was of the greatest assistance to Scotchmen

who had business in London. Instead of travelling on horseback, which took many days and was tedious and expensive, one could ride in a public coach drawn by eight horses. The stage that ran between Glasgow and London carried linen and cotton goods to the English market in addition to passengers. It covered about twenty-five miles a day, and was three weeks upon the road, with a rest at a tavern each Sunday. From Glasgow to Edinburgh there was a two horse stage which started daily from the Saracen's Head in Glasgow at seven in the morning and reached Edinburgh at eight at night. This coach stopped at Cumbernauld for an hour and a half in order to allow the passengers to breakfast and at Linlithgow for dinner. A third halt was made for tea and then the journey was continued to the Grassmarket in Edinburgh.

As traffic increased the heavy, clumsy six-inside vehicle gave way to the light four-inside fast coach. These made much better time, the Mail from London to Holyhead covered the journey of two hundred and sixty-one miles in twenty-seven hours and the route of two hundred and three miles to Liverpool in twenty-one hours. The trip from the capital to Shrewsbury or Exeter or Manchester could be made in a day, and after the Prince Regent chose Brighton as his seaside residence and built the great Pavilion there fast coaches brought the fashionables of London to the Prince's resort at a speed of twelve miles an hour. These coaches used a horse for every mile of

the road, and it is recorded that one hundred and fifty horses were kept to supply the "Wonder" coach that made the one hundred and fifty-eight miles from London to Shrewsbury.

With the general use of the stagecoach the roads were constantly improved. The main highways, or post roads, generally built of gravel, were carefully graded and repaired, and when Macadam perfected his process of treating the surfaces the principal thoroughfares of the kingdom were hard and smooth and free from ruts. The Royal Mail, with twelve or more passengers and their luggage on top, bowled merrily along at ten or twelve miles an hour through all kinds of weather. Sometimes they travelled both by day and night, but generally the journey was made from dawn to sunset.

The lord of the road was the coachman, who was as proud of his vehicle as a sea-captain of his ship. Usually a portly, well-seasoned individual, he handled reins and whip with a flourish and pointed out to the fortunate passenger who had the seat beside him choice bits of scenery and regaled him with stories of the road. The guard, although greatly inferior to the coachman in importance, was often almost as resplendent in a coat of scarlet cloth with trimmings of black velvet and gold lace. He carried a blunderbuss and sometimes a brace of pistols and made a great show of his weapons when any strange horsemen appeared.

On the journey private chaises were met, for there

were those who preferred to hire vehicles of their own rather than ride with the crowd. An American traveller in England wrote that he often saw such chaises "with one or more inmates reclining luxuriously amidst silken cushions, absorbed in a book—or, quite as frequently the case, lost in less sentimental oblivion. . . . The carriage ordinarily hired, at a post house, is a light chariot with seats for two, furnished with glass windows and blinds in front, and in the doors on either side. The post boy, dressed in a gay jacket of red, yellow or blue, with a jockey cap, white pantaloons, or small-clothes and long boots, does not usually drive from a box in front like a coachman, but rides on one of the horses as postillion; and thus, an unobstructed view of the country around, is enjoyed from within."

To ride atop a coach in fair weather was one thing, to ride outside in a heavy rain was quite another. One traveller says that in a downpour the passengers all "put up umbrellas; that of my neighbor turned a stream of water down my neck, and I with mine turned a current into his lap; we moved a little and took it in another place, and then in another, till we all thought it more equal to take the shower as the clouds dropped it."

But the inside of the coach was dark and stuffy and most preferred to ride on top where the country could be seen and the coachman's stories heard. And in clement weather such a journey was a delight, filled

with amusing experiences, as the account of a day's ride from London to Bath made by Lord William Pitt Lennox, a young gentleman of fashion, quaintly shows. "It was early in a morning," says Lord William, "in the merry month of May, when I found myself at the 'White Horse Cellar,' Piccadilly, just as the York House coach was starting for Bath. I had previously secured the box seat, and, encased in a double-breasted drab coat, waited the arrival of a noble Duke, then a Marquis, well known to all the best coachmen on the road as a most liberal patron, and a first-rate whip himself.

" 'Sorry to have kept you,' said the new-comer, 'but Swaine only sent home the whip I promised you this morning; you will find it in this narrow deal case.'

" 'Allow me to give up my place to you,' I said, addressing the Marquis.

" 'Thank you a thousand times,' he replied, 'I am unfortunately engaged. We are going to man my new cutter, and pull to the Red House and back.'

"The case was handed up; the dragsman expressed his thanks.

" 'All right behind, gentlemen,' he thundered, fingering the ribbons in the plenitude of vehicular importance. Away we went, rattling along the stony pavement of Piccadilly at an awful rate to make up for the lost time.

" 'Nice morning, Sir,' said my companion, as we passed through the turnpike-gate that then stood op-

posite the entrance to the Park, near Apsley House. 'The flowers are all a-blowing and a-growing.' This line he sang, and then continued, 'My missus gave me these beautiful violets about an hour ago. "Sam," said she, "I know I can trust you not to give them away to any girls on the road."'

"I turned round to admire the bouquet and take a look at the wearer. . . . He was a well-dressed, natty-looking fellow, decked out in a neat dark brown coat, white hat, corduroy breeches, well polished boots, cloth leggings, and a splendid pair of double-sewn buckskin gloves. A huge pair of whiskers, shaped like a mutton chop, fringed the borders of each cheek, and were (as a costermonger in Knightsbridge irreverently remarked) large enough to pad a cart-saddle. In the course of conversation he invariably indulged the outside passengers with snatches of the popular ditties of the day, 'Oh, say not woman's heart is bought,' 'Love has eyes,' 'Will you come to the bower?' 'Savourneen Deelish,' 'The Thorn,' and 'Sally in our Alley.' . . .

"As I had won the good graces of this driving Giovanni, . . . he offered me the reins just after passing the 'Sun Inn' at Maidenhead. 'Take 'em gently up the hill,' said he, 'and then you can have a spirt over the thicket.'

"To say that I was proud is to say nothing, for, having passed a few months with a private tutor at Littlewick Green, within two miles of the spot where we were, I felt that I should cut no little figure as I

drove by the 'Coach and Horses,' a wayside public-house where I and my companions used to keep our guns when at our tutor's.

" 'Do you pull up at the "Coach and Horses"?' I inquired.

" 'We can, Sir, if you like,' the coachman responded. 'Perhaps Dick has a parcel to leave for Squire Lee. Anything for the thicket?' he continued, turning to the 'shooter' behind. . . .

" 'Why, yes, Sam; I wish to know whether Mr. Vansittart has sent for the empty sack I left there last Monday.' "

At the "Coach and Horses" Lord William pulled up and the innkeeper's daughter, seeing the coach stop, rushed to the door, exclaiming.

"Lord William! Who would have thought it!" she cried. "How much you have improved in driving! Do you recollect when you upset the dog-cart close to that pond?"

Whereupon Lord William continues: " 'I hope your father is well,' I replied, anxious to change the conversation; 'and Sally—I mean Miss Sadbroke—let the coachman and guard have a glass of your cream of the valley.'

" 'Pray alight, my Lord,' said the coachman, 'I was not aware who I had the honour of addressing. Dick, show his Lordship into the bar.'

"I jumped down, rushed into the well-known snuggery, . . . quaffed a glass of bright, sparkling ale, threw down a crown piece, kissed my hand to the

blooming girl, and mounted the box. . . . We trotted past my tutor's house on the green, where I was cheered by the boys of the village school, and, after an agreeable drive, reached Reading and then Newbury. Here the passengers were allowed twenty minutes for dinner, where we (I can answer for myself) did ample justice to the fare, which consisted of a splendid boiled leg of mutton and a ham-and-veal pie.

" 'I go no further, gentlemen,' said the coachman.

" 'All right,' I responded, handing him a gold seven-shilling piece.

" 'Good morning! and thank you, my Lord,' replied the deposed monarch of the whip. 'I've told Mr. Dennis that your Lordship has your driving-gloves on.'

"Again mounting the box, I found myself seated by one of the smartest men I ever met with at that period on the road. There was an air of conceit about him that was truly amusing, and it was rendered doubly so by his affected style of conversation. Unlike other dragsmen, he was dressed in the plainest style imaginable—a well-brushed black beaver hat, glossier than silk; a brown cutaway coat, dark Oxford mixed overalls, highly-polished Wellington boots, and fawn-coloured double kid gloves. The first object of my new companion was to inform me that he was well born, that he had been educated at Oxford, and that he was the most popular man at Bath; indeed, so much so that he was called the Beau Nash of the road. . . .

"On leaving Marlborough, he offered me the reins, which I accepted. . . . Upon reaching the city and driving up to the 'York House,' Mr. Dennis, with the air of Louis le Grand, politely took off his hat, wished me good evening, thanked me for my gratuity, and said that if I mentioned his name at the hotel every attention would be paid to me."

Travelling by stagecoach, even in fair weather, however, had its hardships as well as its pleasures, especially when part of the journey was made at night. David Copperfield, when sent away to school, had an outside seat on a coach that left Yarmouth at three in the afternoon and was due in London about eight next morning. It was midsummer and the evening was fine. The small boy says: "The night was not so pleasant as the evening, for it got chilly; and being put between two gentlemen . . . to prevent my tumbling off the coach, I was nearly smothered by their falling asleep, and completely blocking me up. They squeezed me so hard sometimes that I could not help crying out, 'Oh, if you please!'—which they didn't like at all, because it woke them. Opposite me was an elderly lady in a great fur cloak, who looked in the dark more like a haystack than a lady, she was wrapped up to such a degree. This lady had a basket with her, and she hadn't known what to do with it for a long time, until she found that, on account of my legs being short, it could go underneath me. It cramped and hurt me so, that it made me perfectly miserable; but if I moved in the least, and made a

glass that was in the basket rattle against something else (as it was sure to do), she gave me the cruellest poke with her foot, and said, 'Come, don't *you* fidget. *Your* bones are young enough, *I*'m sure!' "

After such a journey David Copperfield or any other traveller was glad enough to ease his limbs and satisfy his appetite when the coach pulled up at an inn.

§ II

INNS

The inn was of great importance in coaching days, for it was there that the traveller, having ridden perhaps for hours in a cramped position, buffeted by wind or rain, chilled by the cold of winter or scorched by the summer's sun, hungry and thirsty, could rest and refresh himself at the blazing fire on the hearth or in the shade of the garden. At inns stops were made to water or change the horses, to permit the coachman and passengers to obtain food and drink, and to secure a night's lodging when the journey was a long one and the coach did not travel after dark. These public-houses were of all varieties, from the pretentious Elephant and Castle, which was the great coach terminal one mile from London Bridge, to the little roadside tavern that nestled in some sheltered nook of the Devon or Yorkshire downs. The hotels in the cities were comfortable and commodious, but

it was the wayside inns that charmed the traveller. Washington Irving pictured these: "As we drove into the great gateway of the inn," he says, "I saw on one side the rousing light of a kitchen fire beaming through a window. I entered, and admired for the hundredth time, that picture of convenience, neatness, and broad honest enjoyment, the kitchen of an English inn." To that picture he added the pleasing vision of fat hams, fine flitches of bacon, gleaming copper kettles, a capacious table for the customer garnished with a cold round of beef and plenty of foaming tankards.

The country inns were usually divided into two departments, the parlor and the kitchen, the former for the accommodation of people of quality and the latter for the humbler class of travellers. In the inn-yards there was always a plentiful supply of chaises and horses, ready for use at very short notice. In addition to the regular coaching taverns there were also many roadside alehouses, where travellers who could not afford the luxury of the inns were able to take shelter. Smollett describes such an alehouse in his novel "Sir Launcelot Greaves." "The kitchen," he says, "was the only room for entertainment in the house, paved with red bricks, remarkably clean, furnished with three or four Windsor chairs, adorned with shining plates of pewter and copper saucepans nicely scoured, that even dazzled the eyes of the beholder."

It was delightful in winter to step from the cold of

the highroad into the cozy inn-parlor or kitchen and almost equally agreeable in summer to exchange the hostelries of the hot and crowded towns for the clean-smelling and breeze-swept places of entertainment that were to be found on all the coaching roads. Here were roses and honeysuckle, wide spreading trees, trim gardens of flowers and fruits, as well as fresh butter, rich country cream and new-laid eggs. Frequently the wayside inns were situated by winding rivers, with a view of an ancient bridge or picturesque mill, sometimes they boasted extensive views of rolling country, of lakes or mountains, and the traveller could feast his eyes on the beauties of rural nature while he satisfied the inner man.

The innkeeper and his wife, amiable and full of entertaining gossip, would seek to beguile him to stay and order something more, but the coachman would mount his box-seat and the traveller must pay his score and hasten or be left behind. Usually about fifteen minutes were allowed for a tavern lunch of beef, pudding, and cheese, then the guard would sound his horn and the party be off again.

It would seem that ample opportunity was given for refreshment in coaching days, for when an early start was made a stop was customary to permit of breakfast on the road, another for lunch and another for tea, with a substantial dinner at the end of the ride. Notwithstanding this, many travellers took their own provisions with them lest they get hungry on the way. Sir John Vanbrugh wrote an amusing

description of the journey of a family up to London from the country by coach; in this he says that "for fear of a famine before they could get to the baiting-place, there were such baskets of plum-cake, Dutch gingerbread, Cheshire cheese, Naples biscuits, macaroons, neats' tongues, and cold boiled beef—and in case of sickness, such bottles of usquebagh, black cherry brandy, cinnamon-water, sack, tent, and strong beer, as made the old coach crack again; and for defence of this good cheer and my Lady's little pearl necklace, there was the family basket-hilt sword, the great Turkish scimitar, the old blunderbuss, a good bag of bullets, and a great horn of gunpowder."

§ III

ADVENTURES WITH HIGHWAYMEN

There were plenty of highwaymen to be met with in coaching days, for these gentry frequented every main road in England. Hounslow Heath on the Great West Road and Finchley Common on the Great North Road were their favorite resorts, but on every open common and steep hill coaches might be held up by masked men armed with pistols. Robberies were of daily occurrence and often it was suspected that innkeepers were in league with the highwaymen and gave the latter information as to wealthy travellers. Mail coaches were plundered of money; in 1814 the

Stroud Mail was robbed of bank-notes amounting to two thousand, eight hundred pounds, and the following year the Buckingham stagecoach was robbed of a large quantity of bills and notes.

Sometimes the victims of highwaymen advertised for the return of articles of special value to the owner. This notice appeared in the Salisbury *Flying Post* in 1696:

"Whereas six gentlemen (all of the same honourable profession), having been more than ordinary put to it for a little pocket money, did, on the 14th instant, in the evening, near Kentish Town, borrow of two persons (in a coach) a certain sum of money, without staying to give bond for the repayment, and whereas fancy was taken to the hat, peruke, cravat, sword, and cane of one of the creditors, which were all lent as freely as the money; these are, therefore, to desire the said worthies, how fond soever they may be of the other loans, to unfancy the cane again, and send it to Will's Coffee-House in Scotland-yard, it being too short for any such proper gentlemen as they are to walk with, and too small for any of their important uses, and withal only valuable as having been the gift of a friend."

It does not appear whether the highwaymen were as politely good-humored as their victim and returned him the cane.

These "knights of the road," as the highwaymen were commonly styled, seem to have been regarded by the public as rather romantic characters and were often admired for their daring. When George II was

king they reached the height of their fame and all the roads in the neighborhood of London were infested with them. Dick Turpin carried on business along the Great North Road and in Epping Forest, in company with Captain Macheath and Jerry Abershaw, while other celebrated rascals frequented other heaths and commons near the city, all of which were overgrown with thick furze bushes and were undrained and uncultivated. Dick Turpin was what was known as a "flying highwayman," because of the speed with which he rode and his quickness in evading capture; there were also "gentlemen highwaymen", such as Thomas King and Maclean, who were impecunious gentlemen of good families, seeking to retrieve their fortunes at the expense of the travelling public. The celebrated Claude Duval was a "knight of the road" famed for his gallantry and politeness towards those whom he robbed, especially towards ladies. He would request them with the greatest courtesy to "favor" him with any valuables they carried and make the most abject apologies for any inconvenience or alarm he might have occasioned. Sometimes he would even return certain articles that were specially prized by their owners and he always made a graceful bow when he closed the coach door, accompanied by the salutation "good night and a pleasant journey to you."

Of course there were brutal highwaymen, and all of them were rascals, but the debonair dash of such as Dick Turpin and Claude Duval, together with the

stories that some of them, like Robin Hood, shared with the poor what they took from the rich, cast a halo of sentiment about them in the eyes of the simple and ignorant and made them the object of sympathy and adulation when they were captured by the king's officers and put on trial for their crimes.

Even in the streets of London highwaymen abounded, and as late as 1750 carriages were stopped in Hyde Park and Piccadilly at noonday and pistols thrust at the breasts of the occupants. Sometimes the robbers were bamboozled by fashionable ladies. Lady Walpole writes in her letters: "Lady Browne and I were, as usual, going to the Duchess of Montrose's at seven o'clock. The evening was dark. In the close lane, under the park pale, and within twenty yards of the gate, a black figure pushed by between the chaise and the hedge on my side. I suspected it was a highwayman, and so, I found, did Browne, for she was speaking, and stopped. To divert her fears I was going to say, 'Is not that the apothecary going to the Duchess?' when I heard a voice cry 'Stop!' and then the figure came back to the chaise. I had the presence of mind before I let down the glass, to take out my watch and stuff it within my dress under the arm. He said,

" 'Your purses and watches?'

" 'I have no watch,' I replied.

" 'Then, your purse.'

"I gave it to him; it had nine guineas in it. It was so dark that I could not see his hand, but I felt him

take it. He then asked for Lady Browne's purse, and said,

" 'Don't be frightened, I will not hurt you.'

" 'No, you won't frighten the lady,' I said.

" 'No, I give you my word I will not hurt you,' he replied.

"Lady Browne gave him her purse, and was going to add her watch; but he said,

" 'I am much obliged to you; I wish you good night,' pulled off his hat, and rode away.

" 'Well,' said I, 'you will not be afraid of being robbed another time, for, you see, there is nothing in it.'

" 'Oh! but I am,' she said; 'and now I am in terror lest he return, for I have given him a purse with bad money in it, that I carry on purpose.' "

There was in 1761 a "knight of the road" known as the "Flying Highwayman" who plied his trade on all the roads outside London. He rode three different horses, a gray, a sorrel, and a black, and the last had a black face, over which he customarily hung a black cat's skin for concealment. Hawkes was the name of this man, and he was known by sight to most of the turnpike men and did a lucrative business, especially on the Bath and Oxford roads. He behaved politely to those he robbed, as did another of his trade who, after having stopped two travellers on horseback near Maidenhead and then taken thirty guineas from them, learned that they were going to Bath and courteously returned them a couple of guineas to pay their

expenses. Another highwayman, Captain McClean, accidentally wounded a gentleman when halting a coach, and not only sent him two letters of apology but wrote him that if there were any valuables he particularly wanted to regain he should be happy to meet him by Tyburn Gate at midnight and sell them to him for a small sum. An Irish gentleman writing an account of his journey through England in 1752, spoke with satisfaction of his having traversed "the large open plain called Finchley Common, so celebrated for the frequent murders and robberies committed there," and related how an apothecary to cheer the coach company told them how five stagecoaches had been robbed by a single man, "and they all together." The Irishman continues, "We travelled here under some anxiety, and suspected every bush for a tory. Many gibbets are up over all this common, and I saw no less than five within a pistol-shot of each other, which made me wonder it did not deter these villains from such practices."

So easily did single highwaymen succeed in robbing stagecoaches that it was often suspected that the coachmen and guards were friends of theirs and perhaps shared some of their ill-gotten gains.

The newspapers of the period are full of the deeds of the "knights of the road." Two will suffice for examples. The *Public Advertiser* records on April 22, 1790:

"Saturday last, at noon, a most daring robbery was

committed by four highwaymen, well mounted, on the common about a mile and a half beyond Maidenhead. They stopped and robbed a lady and gentleman in a postchaise, although there was another chaise, one of the Oxford post coaches, and other carriages, besides gentlemen and servants riding on horseback on the Common at the same time, and not many hundred yards from the spot. After having done their business, they galloped off down the Common in a direction for Windsor. The robbers had crape over their faces."

The *Morning Chronicle* on January 14, 1797 states:

"A very gallant highway robbery was lately committed on Wimbledon Common upon the person of a young married lady. After receiving her purse, the robber politely demanded an elegant ring which he discovered on her finger. This she peremptorily refused, saying, 'She would sooner part with life'; the hero of the turf rejoined, 'Since you value the ring so much, madam, allow me the honour of saluting the fair hand which wears it, and I shall deem it a full equivalent!' The hand was instantly stretched through the chariot window, and the kiss being received, the highwayman thanked her for her condescension, and instantly galloped off perfectly satisfied with the commutation."

In spite of such gallant encounters, however, highwaymen were more agreeable to read of in romances

or see enacted on the stage than to be met with on lonely roads, and the multitude of these gentry, masked, well armed, and mounted on fleet horses, was the chief drawback to travel in coaching days.

2

THE STEAM RAILWAY

§ I

THE DAWN OF A NEW IDEA

MEN probably laughed at Roger Bacon, who said about 1216 that carriages would some day move without horses, and they certainly laughed at Solomon de Caus, a Frenchman, was was confined in an asylum in Paris on account of his mad notions, among which was the proposition that steam might be employed for the propulsion of carriages on land and ships at sea. The English Marquis of Worcester visited De Caus in 1641, heard some of his novel ideas concerning the use of the steam of boiling water, read a book on the subject he had written, and went home and built a steam-engine. Of this nobleman Macaulay wrote: "The Marquis had observed the expansive power of moisture rarified by heat. After many experiments, he had succeeded in constructing a rude steam-engine, which he called a fire-waterwork, and which he pronounced to

be an admirable and most forcible instrument of propulsion.''

The Marquis, however, like Solomon de Caus, and many other inventors and explorers, was suspected of being mad and his fire-waterwork was regarded merely as a toy. Next Savery, a Cornish miner and engineer, built an engine for the purpose of raising water by the aid of fire and proposed the use of steam for propelling carriages on roads. He took no steps to carry out this suggestion in practical form, but by the middle of the eighteenth century the theory that had been laughed at in earlier days was attracting the attention of many experimental minds. Among those now interested was James Watt, to whom the idea was introduced by Dr. Robinson, a student at Glasgow, in 1759. ''He threw out,'' said Watt, ''the idea of applying the power of the steam-engine to the moving of wheel-carriages, and to other purposes; but the scheme was not matured, and was soon abandoned, on his going abroad.''

Watt made use of this idea to the extent of describing an engine in which the expansive force of steam was utilized as the motive power in the specification of his patent of 1769 and also in that of 1784. Others were busy with the subject; a friend wrote to Watt that ''one Moore, a linendraper of London, had taken out a patent for moving wheel-carriages by steam''; the linendraper, however, did not put his invention in practice, and Watt, although he described such a steam-driven vehicle, was too busy perfecting his

condensing engine to build his proposed locomotive.

The first actual model of a steam-carriage, of which there is a record, was made by Cugnot, a Frenchman, who demonstrated his model to the Marshal de Saxe in 1763. With funds supplied by the French king he constructed an engine, but when it was set in motion it promptly proceeded to knock down a wall which was in its way. Regarded, therefore, as too dangerous a machine for ordinary purposes, Cugnot's engine was stored as a curiosity in the Arsenal Museum at Paris. An American, Oliver Evans, invented a steam-carriage in 1772 and later obtained from the State of Maryland the exclusive right to make and use such a vehicle, but did not follow up his invention. William Symington in 1786 exhibited the working model of a steam-carriage he had constructed to some professors of Edinburgh. The Scotch roads were so nearly impassable, however, that Symington gave over his steam-carriage and turned his attention to perfecting a steamboat.

William Murdoch, an assistant of Watt, built the first English model of a steam-carriage in 1784, constructed on the high-pressure principle and with three wheels. The boiler was heated by a spirit-lamp, and the entire machine was little more than a foot in height. One night, after returning from work at the mine in Redruth, Cornwall, Murdoch decided to try out his little locomotive and took it to the walk leading to a country church on the outskirts of town. The walk was narrow and bounded by high hedges. The

inventor lighted his lamp, the water began to boil, and off went the engine, followed by Murdoch. The night was dark. The locomotive gained speed, and then were heard shouts from the road ahead. Hurrying his steps, Murdoch found that the clergyman of the parish, walking towards town, had encountered the hissing little demon, which he had taken to be a manifestation of Satan.

While various inventors were thus busied, the labor of working the coal mines of England was much simplified by the adoption of rail- and tram-roads, worked by horses. Watt's invention of the steam-engine had given a great impetus to manufacturing and trade of all kinds and soon it was proposed to extend the use of railroads from the collieries to the transportation of merchandise from town to town, especially in those districts where there were no canals available. In 1801 Dr. James Anderson, of Edinburgh, urged the general adoption of railways, worked by horse-power, on turnpike roads. "Diminish carriage expense but one farthing," said he, "and you widen the circle of intercourse; you form, as it were, a new creation, not only of stones and earth, and trees and plants, but of men also, and, what is more, of industry, happiness, and joy." The next year Mr. Edgeworth suggested a plan for the carriage of passengers. "Stage-coaches," he declared, "might be made to go at six miles an hour, and post-chaises and gentlemen's travelling carriages at eight, —both with one horse; and small stationary steam-

engines, placed from distance to distance, might be made, by means of circulating chains, to draw the carriages, with a great diminution of horse-labour and expense."

Then Richard Trevethick, a captain in a Cornish tin-mine and a pupil of William Murdoch, determined to build a steam-carriage to use on country roads. He took out a patent in 1802. The carriage he constructed looked like the ordinary four-wheeled stagecoach. It had one horizontal cylinder, which, with the boiler and the furnace-box, was placed in the rear of the hind axle; the motion of the piston was transmitted to a separate crank-axle, from which the axle of the driving-wheel derived its motion. This was the first successful high-pressure engine built on the principle of moving a piston by the elasticity of steam against the pressure only of the atmosphere.

Trevethick's steam-carriage excited considerable interest in Cornwall, but as that district was so remote from the commercial world the inventor and his cousin, Andrew Vivian, decided to take it to London to exhibit to business men. They set out with the locomotive for Plymouth, from which port it was to be conveyed to the metropolis by ship. As the two drove along the road their carriage battered down the rails of a gentleman's garden, but went merrily on. Then Vivian sighted a closed toll-gate on the highway ahead and called to Trevethick, who was seated behind, to slacken speed. The latter at once shut off steam, but the momentum of the carriage

was so great that it went some distance and stopped just at the gate, which was opened like lightning by the toll-keeper.

"What have us got to pay here?" asked Vivian.

"Na—na—na—na!" stammered the gateman, trembling in every limb, and his teeth chattering as if he had the ague.

"What have us got to pay, I say?" repeated Vivian.

"Na—noth—nothing to pay! My de—dear Mr. Devil, do drive on as fast as you can! Nothing to pay!"

The locomotive arrived safely in London, was exhibited publicly, and pulled behind it a wheel-carriage filled with passengers. Crowds flocked to see it, but, actuated by some strange impulse, Trevethick gave over the exhibition and took his engine away. It had attracted much attention, however, and Sir Humphrey Davy, the inventor of the safety-lamp for use in mines, wrote to a friend: "I shall hope soon to hear that the roads of England are the haunts of Captain Trevethick's dragons—a characteristic name."

Such was the state of the roads that it was regarded as impractical to run a steam-carriage on them, and Trevethick gave up the notion of putting his invention to general use.

His interest in the subject of steam locomotion was presently renewed by hearing of large wagers a gentleman was making as to the weight which could be

hauled by a single horse on the Wandsworth and Croydon iron tramway. The number and weight of wagons that a horse could draw was surprising, and Trevethick now studied the problem from a new angle, the combination of a steam-carriage and iron rails on which it might travel. He built a new type of carriage for this purpose and tried it in 1804 on the Merthyr Tydvil Railway in South Wales. The engine at its first demonstration succeeded in drawing after it several wagons containing ten tons of bar-iron at a rate of about five miles an hour. The boiler of this engine was cylindrical, flat at the ends, and made of cast-iron. The furnace and flue were inside the boiler, within which the single cylinder was immersed upright. The motion of the wheels was produced by spur-gear, to which was added a fly-wheel on one side. The waste steam was thrown into the chimney through a tube inserted in it at right angles, an arrangement not designed to produce any result in the way of a steam-blast in the chimney, but intended, it would seem, to get rid of the nuisance caused by throwing the jet directly into the air. The inventor was on the verge of making a great discovery, but that he was unaware of the action of the blast in contributing to increase the draught and so quicken combustion is evident from the fact that he used bellows for this purpose.

This engine, however, like Trevethick's first steam-carriage, was a practical failure. It drew a considerable load at a fair rate of speed, but its jolting motion

champed up the cast-iron roadway, which was not constructed to bear so much weight. This matter of weight indeed seems to have presented an obstacle to many experimenters, who considered that if any heavy load were placed behind the engine the "grip" or "bite" of the smooth wheels of the locomotive upon the smooth iron rail would be so slight that the wheels would slip upon the rail and consequently that the locomotive would not make any progress. In an attempt to obviate this Trevethick had suggested that the periphery of the driving-wheels of the engine should be made rough by the projection of bolts or cross-grooves; this plan had been adopted in the locomotive used on the Merthyr Tydvil Railway, with the result that its progress had been a succession of jolts very trying to the rails of the mine tram-road.

Mines and cotton-mills were now more busy than ever and the increase of trade throughout England called for better means of transport than by horse-power. The steam-engine appeared to be the answer, and the problem of the moment was to discover a more effectual adhesion between the wheels and the rails. Mr. Blenkinsop, of Leeds, in 1811 took out a patent for a racked- or tooth-rail to be laid at one side of the road, into which the toothed-wheel of the locomotive should work as pinions do in a rack. The boiler of his engine was supported by a carriage with four wheels without teeth, and rested directly on the axles. These wheels were independent of the working parts of the engine and merely supported its weight

on the rails, the progress being made by means of the cogged wheel working in the cogged-rail. The engine had a double cylinder, the invention of Matthew Murray, a mechanical engineer of Leeds. The connecting-rods gave the motion to two pinions by cranks at right angles to each other; these pinions communicated the motion to the wheel that worked in the toothed-rail.

Blenkinsop's engines were put into use on the railway from the Middleton collieries to Leeds, a distance of about three miles and a half. They succeeded in drawing as many as thirty coal-wagons at a speed of about three miles and a quarter an hour. They were employed for many years in hauling coal and constituted the first regular use of locomotive power for commercial purposes.

Other plans were devised to solve the problem of adhesion between the wheel and the rail. The Messrs. Chapman, of Newcastle, invented a locomotive that worked along the road by means of a chain that was stretched from one end of it to the other. This chain was passed around a grooved barrel-wheel under the engine, and when the wheel turned the locomotive pulled itself along the railway. This method proved very clumsy and the mechanism was so expensive and so difficult to keep in repair that the invention was soon discarded. William Brunton, of the Butterly Works, in Derbyshire, patented in 1813 his Mechanical Traveller, a locomotive provided with legs and feet, that worked alternately at the rear of the en-

gine like the limbs of a horse. In one of its trial runs the engine of this strange device unfortunately exploded and killed several bystanders, and the locomotive was sent to the scrap-heap, although other steam-carriages with legs were subsequently built and some of these were used outside London, where they climbed steep hills with surprising ease. All over the country odd-looking steam monsters were now puffing and prancing, as many men tried to work out the problem of locomotive traction upon railways.

A mine owner in the North of England, Mr. Blackett, of Wylam, made many experiments. The Wylam wagon-way was constructed of wooden rails laid between the colliery at Wylam and the village of Lemington, four miles down the Tyne. At Lemington the coal was loaded in barges and floated down the river past Newcastle and thence shipped to the London market. Each coal wagon from the mine was drawn by one horse, with a man in charge. This method of transport was so slow that only two trips were made by each man and horse in one day and three on the day following. In an effort to improve this condition Blackett took up the wooden road in 1808 and built a "plateway" of cast-iron, a single line with sidings. This new road proved so much smoother that a horse was able to draw two wagons over it instead of one. Then Blackett decided to try locomotive power and altered the road so that he might use the rack-rail and toothed driving-wheel worked out by Blenkinsop. He had an engine built according to Trevethick's

patent, a very awkward affair which, when set on the rails, would not move an inch. Undiscouraged, he constructed another, which proved more successful, and was found capable of drawing eight or nine loaded coal wagons from the mine to Lemington. Its weight, however, was so great that the cast-iron plates on which it ran were constantly breaking. In addition it frequently got out of order, so that horses had to follow it to pull the wagons when the engine ceased its efforts, and it required so much attention in the way of repairs that the workmen declared it "a perfect plague."

One dark evening "Black Billy," as the locomotive was named, was puffing along the High Street Road on its way up from Newburn. A stranger, who had never heard of the engine, was walking on the road and suddenly encountered the iron monster, working its piston up and down, snorting out loud blasts of steam and puffing fire and smoke. Frightened almost out of his senses, the stranger jumped a hedge, fled across the fields, and cried to the first person he met that he had just seen a "terrible deevil on the High Street Road." The story went around, and many were the jeers cast at Blackett on account of this "deevil" of his that scared wayfarers and set fire to trees and fields.

Notwithstanding jeers and opposition Blackett continued his experiments, studying now the proportion which the power of the engine should bear to the weight, and ultimately demonstrated that the

weight of the engine would of itself produce sufficient adhesion to the rails to enable it to draw the requisite number of wagons on a smooth tram-road. This put an end to the fallacy on that point that had previously been such an obstacle to the use of steam-carriages, and proved that rack-rails, toothed-wheels, chains and legs were all unnecessary for the successful traction of loaded wagons on a road that was moderately level.

The steam that blew into the air at high pressure from the piston while the locomotive was moving considerably annoyed horses on the Wylam road, which was a public highway, and one of the neighbors threatened to take steps to prevent the nuisance. To diminish this objection to his plan Blackett gave orders that whenever any horse, or vehicle drawn by horses, came into view, the engine was to be stopped and the blast of steam discontinued until the animals were out of sight. This course of procedure caused much inconvenience to those who ran the locomotive, and so this scheme was adopted: a reservoir was provided directly behind the chimney, into which the waste steam was thrown after it had been used in the cylinder; from this reservoir the steam could gradually escape into the air without noise. This plan was devised expressly for the object of preventing any blast in the chimney, but the great value of this innovation was not appreciated until George Stephenson built his locomotive and established the steam railway in England.

A Rider Bearing a Red Flag Preceded the First Locomotives in England

§ II

GEORGE STEPHENSON'S LOCOMOTIVES

The Wylam wagon-way passed close in front of the cottage in which George Stephenson was born and one of the earliest sights with which his eyes became familiar was that of the coal-wagons being drawn by horses along the wooden tram-road. The boy, born in 1781, was early employed in the colliery; he was eighteen years old before he learned to read, at which time he was earning twelve shillings a week and had charge of an engine in the mine, which occupied him twelve hours a day. A sober, steady, and expert workman, he managed to lay aside enough money to enable him to marry and establish a home of his own at Willington Quay, where he was engaged as brakesman at the Ballast Hill, on the north bank of the Tyne, about six miles below Newcastle. Here his son Robert was born in 1803. From Willington he moved to the West Moor Colliery at Killingworth, and it was there that his remarkable ability as an engineer and inventor began to attract the attention of the mine owners.

While Blackett at Wylam was experimenting with locomotives George Stephenson at Killingworth was studying the same problems. He had already made one important improvement in the colliery machinery; by applying the surplus power of a pumping

steam-engine, stationed in the mine, to the drawing of coal up from the deeper workings he had effected a large reduction in the expenditure on manual and horse labor. He then sought some simplification of the method of hauling the wagons, and for this purpose laid down inclined planes where the nature of the ground would permit. A train of filled wagons was let down the incline by means of a rope that ran over wheels placed along the tram-road, the other end of the rope was attached to a train of empty wagons placed at the bottom of the parallel road on the same incline and dragged them up by the power of gravity. This was a very economical method, but it could be used only on a comparatively small part of the entire length of the road. What was sought was some means of working the coal trains by a "travelling engine" instead of by horses.

Stephenson now applied himself to the study of the locomotives that were already constructed. At Wylam he inspected "Black Billy," and at the collieries of Kenton and Coxlodge he saw one of Blenkinsop's Leeds engines draw sixteen coal wagons with an aggregate weight of seventy tons at the rate of about three miles an hour. Yet this engine proved unsteady and costly to work. An effective and economical locomotive engine still was to be invented, and to this object Stephenson devoted his attention.

Lord Ravensworth, the principal partner in the Killingworth colliery, having a very favorable opinion of Stephenson's ability owing to the important

improvements he had already made, authorized him to construct a locomotive, or what Stephenson called a "travelling engine." The inventor had difficulty in obtaining competent mechanics and satisfactory tools with which to work, but he built a locomotive and it was successfully tried out on the Killingworth Railway in July, 1814. In many ways this locomotive was patterned after Blenkinsop's engine, but the wheels were smooth, for Stephenson was convinced that the adhesion between a smooth wheel and an edge-rail would be as efficient as Blackett had proved it to be between a wheel and a tram-road. This "travelling engine," which was popularly called "Blucher," was the most successful locomotive that had yet been built, but it was nevertheless a cumbersome and clumsy machine; the parts were huddled together, its progress was a succession of jolts which deranged the machinery, it had no springs, and when the teeth of the cogwheel became worn the engine rattled as it moved.

The principal test of the success of the locomotive was its economy as compared with horse power, and it was found that at first the working of the engine was barely economical and at the end of the first year's trial the steam power and the horse power were practically upon a par in point of cost. It could not travel at a speed beyond a horse's walk nor accomplish on an average more than about three miles an hour. Locomotives might have been abandoned at this juncture had not Stephenson hit upon the steam

blast, which at once more than doubled the engine's power.

Stephenson was a remarkably accurate and careful observer and his success was mainly due to the patient study he gave to facts he observed and his application of them to useful account. In his first locomotive the eduction steam was allowed to escape into the atmosphere with a hissing blast, which frightened horses and cattle, and caused a neighboring land-owner to threaten suit against the colliery for maintaining a nuisance. The inventor had already noticed the much greater velocity with which the steam issued from the exit pipe than that with which the smoke escaped from the engine's chimney. He thought that, by conveying the eduction steam into the chimney by a small pipe after it had done its work in the cylinders and by allowing it to escape in a vertical direction, its velocity would be imparted to the smoke from the fire, or to the ascending current of air in the chimney, thereby increasing the draught and the intensity of combustion in the furnace.

This theory proved correct; when he tried it out in practice he found that combustion was stimulated by the blast, the capability of the boiler to generate steam was greatly increased, and the engine's effective power was augmented in the same proportion, without adding to its weight. This discovery of the steam blast was all important in the history of railways; without it locomotives would have been scarcely more effective than horse power.

The inventor now built a second locomotive and took out a patent in 1815 for an engine which combined the essential requisites of economical use, few parts, simplicity in construction, and directness in the method by which the power was communicated to the wheels. To obtain that degree of flexibility combined with direct action which was needed to insure power and avoid friction and jar from irregularities in the road Stephenson made use of the "ball and socket" joint for effecting a union between the ends of the cross heads where they united with the connecting rods, and between the ends of the connecting rods where they were united with the crank-pins attached to each driving wheel. In this way the parallelism between the cross head and the axle was at all times maintained.

In this second locomotive, built in 1815, Stephenson had constructed an engine which had these important improvements on all those previously devised: simple and direct communication between the cylinder and the wheels on the rails, joint adhesion of all the wheels, attained by the use of horizontal connecting rods, and a method of increasing the combustion of the fuel by employing the waste steam, which had formerly been allowed to escape into the air.

While busily occupied with his locomotive, Stephenson yet found the opportunity to invent a safety lamp, known as the "Georgy Lamp," which furnished a great protection against explosions of

fire-damp in the coal mines. Meantime his "travelling engine" was regularly employed drawing coal wagons and he was studying how to make it more efficient and economical. He took up the subject of the rails, which at that time were laid in a loose manner and seldom repaired, with the result that there was a great loss of power in the engine and much wear and tear of the machinery from jolts of the wheels against the rails. To remedy this he devised a new chair with a new method of fixing the rails therein; instead of the butt joint which had been used in all cast-iron rails he adopted the half-lap joint, by which the rails extended over each other at the ends, and these ends, instead of resting upon a flat chair, were constructed to rest upon the apex of a curve forming the bottom of the chair. This invention, and that of what he called his Steam Springs—designed to distribute the weight of the engine equally on all the four wheels—greatly increased the smoothness of travel and its economy.

Yet, although the Killingworth railway was in regular use, the possibilities of the locomotive for passenger and goods traffic were slow to be appreciated in England. There were only a few men who glimpsed them as did Mr. Edgeworth, who wrote to James Watt in 1813: "I have always thought that steam would become the universal lord, and that we should in time scorn post-horses. An iron railroad would be a cheaper thing than a road on the common construction." Some did, however, become interested,

and two of the most prominent were William James of West Bromwich and Edward Pease of Darlington.

James, a man of considerable fortune, and financially connected with the coal trade, had seen Trevethick's engine at Merthyr Tydvil, and afterwards, with Lord Redesdale, constructed a railway to be worked by locomotive power between Stratford-on-Avon and Moreton-in-the-Marsh. He projected railroads in various parts of England, but found people in authority constantly opposing his schemes. Edward Pease, of Darlington, like James, was connected with coal mines, and desired to improve the traffic conditions of his neighborhood, so as to obtain new markets for the large stores of coal in the Bishop Auckland valley above Darlington. With this object he planned in 1817 to build a railway from Witton Colliery, a few miles above Darlington, to Stockton.

This project met with much opposition. When Pease tried to organize a company for the purpose of surveying and constructing his road the people of the district ridiculed the notion and predicted it would ruin everyone connected with it; even those who were most interested in acquiring new markets, the merchants and ship-owners, would not contribute money. Pease persevered, and succeeded in inducing his friends and relations, many of whom, like himself, were members of the Society of Friends, to subscribe for shares. "The Quakers' Line" the road was called on account of its sponsors. When permission

of Parliament was sought to build the railway it was refused owing largely to the opposition of the Duke of Cleveland, who objected on the score that the road as proposed passed near one of his fox covers.

A new survey was made, avoiding the duke's preserves, and ultimately, in 1821, Parliament passed the Stockton and Darlington Railway Act.

Meantime the owners of the Hetton Colliery, in the county of Durham, had decided to convert their wagon-way into a locomotive railroad. Knowing of George Stephenson's success with engines at Killingworth, these Durham coal-magnates invited him to become the engineer of their new line, and Stephenson's employers, pleased at the compliment paid their colliery engineer, permitted him to accept the offer. The project was important. The railway extended from the Hetton Colliery to the shipping-place on the banks of the Wear, near Sunderland. Its length was about eight miles and its route crossed Warden Low, one of the highest hills in the district. The character of the country prevented the building of a flat line, or one of easy gradients, except by the spending of much more money than the owners would allow Stephenson. What he had to do was to construct his road to conform to the country it traversed and to adapt the mechanical methods employed for the working of the railway to the character of the gradients, which in some places were heavy.

His achievement was eminently successful. On the Hetton line when completed there were five self-act-

ing inclines, where the full wagons drew the empty ones up, and two inclines that were worked by fixed reciprocating engines of sixty horse-power each. The locomotive "travelling engine" supplied all the other power. The Hetton Railway was opened on November 18, 1822, before crowds of curious spectators, who saw five of Stephenson's locomotives at work under the direction of his brother Robert and shipments of coal being made to the terminals on the Wear. The locomotives travelled at about four miles an hour, and each engine drew a train of seventeen wagons, weighing about sixty-four tons.

In constructing the Hetton Railway George Stephenson had demonstrated his ability not only as a builder of locomotives but as a railroad engineer.

§ III

THE FIRST RAILROAD PROJECTS

Up to this time the main impetus to the construction of railways had come from the owners of collieries; but now an additional incentive appeared in the field. Improved facilities for shipping cotton were needed even more than for shipping coal, and the attention of those interested in steam railroads was diverted from the mining districts of England to the great trade centres of Liverpool and Manchester.

William James, the wealthy promoter of plans for railways, was in Liverpool in 1821 and found there

was much discussion regarding the building of a tramway between that city and Manchester. The increase in trade had been marvellous; in nine years the quantity of raw cotton sent from the one city to the other had increased by 50,000,000 pounds' weight, and other raw materials in proportion. In the neighborhood of Manchester many thriving towns had sprung up, the inhabitants of which were mainly dependent for their livelihood on the regularity of the supply of cotton from Liverpool. The principal means of transport were the Duke of Bridgewater's Canal and navigation on the Irwell and Mersey, but the great volume of trade was outstripping these methods of handling it. Cotton lay at Liverpool for weeks, waiting to be shipped, and it actually took longer to convey the cargoes from that port to Manchester than it had done to bring them from the United States to England. When the canals were frozen communication was stopped and factories were idle. There was the same difficulty in conveying manufactured goods from Manchester to Liverpool for export, and the manufacturers of the one city and the merchants of the other were eager to find some more efficient mode of transit.

A prominent Liverpool merchant, Mr. Sandars, discussed with William James the possibility of constructing a railway, and with the assistance of some others they decided to make a survey for such a line. No sooner had their surveyors started work, however, than farmers and gardeners along the proposed line

rose in arms against them. Men attacked them with pitchforks and sometimes with guns, one of the chain-men was captured by a crowd of miners and almost thrown down a coal-pit, women and children stoned them; sometimes there were regular battles in which the surveying instruments were smashed. At length wet weather set in and the work of surveying was suspended until spring.

William James, having heard of George Stephenson's locomotive, went to Killingworth and inspected the engine. He was much impressed by its power and smoothness of action, and wrote to Mr. Losh, who had been Stephenson's partner in acquiring a patent for the locomotive: "It is the greatest wonder of the age, and the forerunner, as I firmly believe, of the most important changes in the internal communications of the kingdom." As James was a man of influence and was connected with the promoters of the proposed line between Liverpool and Manchester, Stephenson and Losh were desirous of enlisting his aid on behalf of their patented locomotive, and drew up a deed by which in consideration of his giving "his recommendation and best assistance" to their engine they assigned to him one fourth of the profits which might be derived from the employment of their locomotive for railroads which might be constructed south of a line drawn across England from Liverpool to Hull.

In the spring of 1822 the survey of the Liverpool and Manchester line was resumed and, in spite of all

sorts of obstacles, was completed. As, however, the promoters found that there would be great opposition to their scheme in Parliament they shelved their project temporarily while they devoted their efforts to securing friends for the plan.

The Stockton and Darlington Railway had been authorized by Parliament, and one day, late in 1821, two men from Killingworth, Nicholas Wood and George Stephenson, called to see Edward Pease, the sponsor of that line. Stephenson had heard of the passing of the Stockton and Darlington Act and hoped to be employed in constructing the road. Pease took a liking to the inventor. "There was," he afterwards said, "such an honest, sensible look about him, and he seemed so modest and unpretending. He spoke in the strong Northumbrian dialect of his district, and described himself as 'only the engine-wright at Killingworth; that's what he was.' "

Pease discussed his plans with Stephenson. The engineer recommended a railway in preference to a tramroad, in which view Pease was inclined to agree. Next they talked of the tractive power and Pease said that the company had based their whole calculations on the employment of horse power. "I was so satisfied," he said, later in speaking of the conversation, "that a horse upon an iron road would draw ten tons for one ton on a common road, that I felt sure that before long the railway would become the King's Highway."

At this point, however, Stephenson asserted that the locomotive engine with which he had been working for years on the Killingworth Railway was worth fifty horses and that engines constructed on that plan would entirely supersede all horse power upon railroads. "Come over to Killingworth," he said, "and see what my Blucher can do; seeing is believing, sir."

Pease then spoke of the opposition which the railway promoters had to encounter, to which Stephenson rejoined, "I think, sir, I have some knowledge of craniology, and from what I see of your head, I feel sure that if you will fairly *buckle* to this railway, you are the man successfully to carry it through."

"I think so, too," said Pease; "and I may observe to thee, that if thou succeed in making this a good railway, thou may consider thy fortune as good as made."

The upshot of the interview was that Pease, having received satisfactory information as to Stephenson's character and qualifications, engaged him, with the approval of the other directors of the Stockton and Darlington Company, to report concerning the practicability of constructing their railway on a line they had previously surveyed and to recommend any changes or improvements in its course, together with estimates of comparative expenses. This matter of expense was important, as the company had already paid out considerable sums. "We wish thee to proceed," Pease told Stephenson, "in all thy levels, es-

timates, and calculations, with that care and economy which would influence thee if the whole of the work were thy own.''

Stephenson made his survey and reported that, by adopting certain changes, a line shorter by about three miles might be constructed at a considerable saving of expense and at the same time more favorable gradients would be secured. The directors of the company, much pleased, employed him to draw up specifications and contract for materials. Edward Pease went to Killingworth, saw Stephenson's locomotive at work, and was so much impressed by it that he formed a partnership with the inventor for the establishment of a locomotive foundry and factory in the town of Newcastle. The Stockton and Darlington Railway was now to be constructed and Stephenson was appointed the company's engineer.

In making the working survey of the line Stephenson went over every foot of the ground himself, accompanied by his assistants. With Pease and the other directors he discussed three important points from every angle: the comparative merits of cast- and wrought-iron rails; the gauge of the railway; the employment of horse or engine power in working it when ready for traffic.

Although he was financially interested in a patent for cast-iron rails, Stephenson advised the directors not to use them. ''They will not stand the weight,'' he said; ''there is no wear in them, and you will be at no end of expense for repairs and re-lays.''

"What kind of road, then," he was asked, "would you recommend?"

"Malleable rails, certainly," he answered; "and I can recommend them with the more confidence from the fact that at Killingworth we have had some Swedish bars laid down—nailed to wooden sleepers—for a period of fourteen years, the wagons passing over them daily; and there they are, in use yet, whereas the cast rails are constantly giving way."

The price of malleable rails, however, was so high that it was decided that only one-half of the quantity required should be of that type and the remainder cast-iron.

The gauge of the road was made 4 feet 8½ inches, which was the gauge of the wheels of the common vehicles in use, such as the carts and wagons that were employed on the first tramways, and the gauge of the Wylam wagon-way, the Killingworth railroad, and the Hetton railroad.

As for the tractive power, fixed engines were to be used at the Brusselton incline, but in general the road was to be worked by horses. Three locomotive engines were ordered from Stephenson's factory at Newcastle, and these were found capable of running at a rate of from twelve to sixteen miles an hour, but they were better adapted for the heavy work of hauling coal trains at low speeds than for the needs of the Stockton and Darlington Railway.

When the road was partly laid Stephenson with his son Robert and John Dixon, a young surveyor, made

a journey of inspection. At Stockton they went to an inn for dinner and Stephenson ordered a bottle of wine to drink success to the railway. "Now lads," Stephenson said, as Dixon reports his words, "I will tell you that I think you will live to see the day, though I may not live so long, when railways will come to supersede almost all other methods of conveyance in this country, when mail coaches will go by railway, and railroads will become the Great Highway for the king and all his subjects. The time is coming when it will be cheaper for a working man to travel on a railway than to walk on foot. I know there are great and almost insurmountable difficulties that will have to be encountered; but what I have said will come to pass as sure as we live. I only wish I may live to see the day, though that I can scarcely hope for, as I know how slow all human progress is, and with what difficulty I have been able to get the locomotive adopted, notwithstanding my more than ten years successful experiment at Killingworth."

The Stockton and Darlington line was opened on September 27, 1825. Great throngs gathered to witness the inauguration of this first public railway, which was laughed at by some, criticized and opposed by many, and only believed in by a few. The journey commenced at the Brusselton incline, about nine miles from Darlington, where the fixed engine drew a train of loaded wagons up the slope from the west and lowered them on the east side. At the foot of the incline was a locomotive, with George Stephenson to

drive the engine. The train consisted of six wagons, loaded with coal and flour, a passenger coach with the directors of the company and their friends, twenty-one wagons fitted with temporary seats for passengers, and six more wagons of coal. The account of a spectator says: "The signal being given, the engine started off with this immense train of carriages; and such was its velocity, that in some parts the speed was frequently 12 miles an hour; and at that time the number of passengers was counted to be 450, which, together with the coals, merchandise, and carriages, would amount to near 90 tons. The engine, with its load, arrived at Darlington, a distance of 8 3/4 miles, in 65 minutes. The six wagons loaded with coals, intended for Darlington, were then left behind; and, obtaining a fresh supply of water and arranging the procession to accommodate a band of music, and numerous passengers from Darlington, the engine set off again, and arrived at Stockton in 3 hours and 7 minutes, including stoppages, the distance being nearly 12 miles."

"The arrival at Stockton," says this observer, "excited a deep interest and admiration." Well might Stephenson be pleased. As the traffic continued the results were such as to surprise and delight even the most enthusiastic of the friends of the road. The company had expected to make its profits principally from the carriage of coal for sale at the stations along the line and did not contemplate the hauling of coal to seaports for export to the London market, but it

was this latter traffic that soon exceeded the former and made the company rich. In a few years the annual shipment of coal, led by the Stockton and Darlington Railway to Stockton and Middlesborough, exceeded five hundred thousand tons.

The passenger traffic over the thirty-seven miles of the road, as well as the export coal business, surprised the directors. The number of travellers between the two towns was small, and it was thought doubtful that many would care to take the risk of riding on a railway; only after some hesitation was Stephenson authorized to have a passenger coach built. The carriage he had constructed according to his plans was a very modest affair, a rude cabin on four wheels. A row of seats ran along each side of the interior and a deal table was fixed in the centre; entrance was by a door at the end, as in an omnibus. This coach Stephenson christened the "Experiment," and it took part in the procession on the opening day.

The "Experiment," drawn by a single horse, made the journey daily between the two towns for a fare of a shilling and each passenger was allowed fourteen pounds of luggage free. It was not worked by the railway company, but was let to a firm of carriers, who paid toll for the use of the line. Proving profitable, several other coaching companies were organized by innkeepers of Darlington and Stockton, and an active competition for passenger traffic sprang up.

The railway carriages used by these rival companies were generally stagecoach bodies, mounted upon an under-frame with flange wheels. The passengers paid different fares, according to whether they rode inside or outside, which corresponded to first and second class. Competition with each other upon the railway and with the regular stagecoaches on the highroad led to increase of speed, and the carriages were presently travelling at the rate of ten miles an hour, which was considered rapid locomotion, and which was the rate of travel of the mail coaches.

Mr. Clephan, a resident of the district, describes some incidents of this rivalry for passenger traffic. Says he: "There were two separate coach companies in Stockton; and amusing collisions sometimes occurred between the drivers—who found on the rail a novel element for contention. Coaches cannot pass each other on the rail as on the road; and at the more westward public-house in Stockton (the Bay Horse, kept by Joe Buckton) the coach was always on the line betimes, reducing its eastward rival to the necessity of waiting patiently (or impatiently) in the rear. Difficulties, too, occurred along the road. The line was single, with four sidings in the mile; and when two coaches met, or two trains, or coach and train, the question arose which of the drivers must go back? This was not always settled in silence. As to trains, it came to a sort of understanding that light wagons should give way to loaded; and

as to trains and coaches, that the passengers should have preference over coals; while Coaches, when they met, must quarrel it out. At length, midway between sidings, a post was erected; and a rule was laid down that he who had passed the pillar must go on, and the 'coming man' go back. At the Goose Pool and Early Nook, it was common for these coaches to stop; and there, as Jonathan would say, passengers and coachmen 'liquored.' . . . One Dixon, who drove the 'Experiment' between Darlington and Shildon, is the inventor of carriage-lighting on the rail. On a dark winter night, having compassion on his passengers, he would buy a penny candle, and place it, lighted, amongst them, on the table of the 'Experiment'—the first railway coach (which, by the way, ended its days at Shildon, as a railway cabin), being also the first coach on the rail (first, second, and third-class jammed all into one) that indulged its customers with light in darkness."

Such was the increase of traffic of all kinds on the Stockton and Darlington Railway that the company soon found it best to take charge of all the business, minerals, merchandise, and passengers. It had been agreed in the company's act of incorporation that the line should be free to all who wished to use it on payment of certain rates and that anyone might put horses and wagons on the rails and carry goods for himself. This led to great confusion and many difficulties. The goods trains became so long that the carriers found it necessary to obtain the aid of the

locomotive engine to help them, and there were mixed trains of passengers and merchandise that complicated the situation further. Therefore the company assumed entire charge of traffic, built new and better carriages for passengers and established a regular passenger service.

This service was of course very primitive. There were no brakes on the carriages, no gates across the turnpike roads, and no signal-lamps. One method of night-signal used when stopping a train was for the engineer to burn a tow-line kindled by a shovelful of red-hot cinders. A candle placed in a station window was the usual signal to stop to take on passengers. The cars had no springs and no buffers, and travellers were treated to continual bumpings and joltings.

From the opening of the railway three of Stephenson's locomotives were regularly employed to pull the coal trains, and these proved very efficient. One day there was a race between No. 1 engine, the "Active," and a stagecoach driven from Darlington to Stockton on the highroad; it was considered a great triumph for Stephenson that the locomotive arrived at Stockton first, beating the coach by about a hundred yards.

For some years, however, most of the hauling was done by horses, which seemed to be the cheaper method, as the inclination of the gradients was towards the sea. The horse would draw the train along the level road until it reached a descending grade, down which the train would run by its own weight.

There the horse would be unharnessed, and then would be wheeled round to the other end of the wagons, to which what was called a "dandy-cart" was attached. Into this cart, which was usually fitted with a well-filled hay-rack, the horse would leap and continue the journey comfortably ensconced in his own dining-coach.

§ IV

PLANS FOR A RAILWAY FROM LIVERPOOL TO MANCHESTER

Stephenson's success with his locomotives at Killingworth and in the construction of the Stockton and Darlington road led to his being employed to survey the projected line between Liverpool and Manchester. In this new work he met continual opposition, not only from the owners of the canal whose monopoly of traffic would be threatened by a railway, and from land-owners and farmers who objected to such a road being located near their fields, but from the general public, who criticized and laughed at what they considered the absurd ideas of this engineer. Stephenson had indeed increased his claims as to what the steam railway would accomplish and declared that it could travel at a speed double that of the fastest mail coach in England. Friends of his urged him to be more moderate in his views, and one of them, Nicholas Wood, wrote: "It is far from my

wish to promulgate to the world that the ridiculous expectations, or rather professions, of the enthusiastic speculator will be realized, and that we shall see engines travelling at the rate of twelve, sixteen, eighteen, or twenty miles an hour. Nothing could do more harm towards their general adoption and improvement, than the promulgation of such nonsense."

Yet Stephenson stood by his guns in face of all ridicule. Parliament took up the subject of the Liverpool and Manchester line, of which Stephenson was now the chief engineer, and a special committee was appointed to question him. The counsel for the railway company was himself rather doubtful as to the wonders promised by the engineer and counseled him not to claim a speed of more than fifteen miles an hour. A member of the committee, thinking to show how ridiculous were Stephenson's views, proceeded to ask questions. "Well, Mr. Stephenson," said he, "perhaps you could go seventeen miles an hour?"

"Yes," was the prompt answer.

"Perhaps some twenty miles might be reached?"

"Yes, certainly."

The member, smiling, continued: "Twenty-five, I dare say, you do not think impossible?"

"Certainly not impossible."

"Dangerous?"

"Certainly not."

"Now tell me, Mr. Stephenson, will you say that you can go thirty miles an hour?"

"Certainly," answered the engineer.

Every committeeman roared with laughter at this simpleton who made such preposterous claims for his railway.

Stephenson, however, was more than a match for any member of that Parliamentary committee who sought to ridicule him. To explain his familiarity with the subject he stated to the honorable gentlemen that he had built fifty-five steam engines, of which sixteen were locomotives. The engines he had constructed for the Killingworth railroad eleven years before were still working with perfect success. He was satisfied that he could prove the safety of using high-pressure locomotives on a railroad and the superiority of this method of transporting goods over all others.

In regard to the charge that locomotives would so frighten horses that it would be difficult to travel on horseback or plough fields in the vicinity of the railway he said that horses quickly learned to take no notice of them and that in the neighborhood of Killingworth the cattle went on grazing while the engines steamed by them. A mail coach, he considered, was more likely to be shied at by horses than a locomotive, and there were some horses that were so skittish they would shy at a wheel-barrow.

One member said in question: "Of course, Mr. Stephenson, when a body is moving upon a road, the greater the velocity the greater the momentum that is generated?"

"Certainly," Stephenson answered.

"What would be the momentum of forty tons moving at the rate of twelve miles an hour?"

"It would be very great."

"Have you seen a railroad that would stand that?"

"Yes."

"Where?"

"Any railroad that would bear going four miles an hour. I mean to say, that if it would bear the weight at four miles an hour, it would bear it at twelve."

"Taking it at four miles an hour, do you mean to say that it would not require a stronger railway to carry the same weight twelve miles an hour?"

"I will give an answer to that. I dare say every person has been over ice when skating, or seen persons go over, and they know that it would bear them at a greater velocity than it would if they went slower; when it goes quick, the weight in a measure ceases."

"Is not that upon the hypothesis that the railroad is perfect?"

"It is; and I mean to make it perfect."

Stephenson was next questioned on the risks of going around curves. "You say that the machine can go at the rate of twelve miles an hour; suppose there is a turn on the road—what will become of the machine?"

"It would go round the turn."

"Would it not go straight forward?"

"No."

"What is to be the plan of the road, and the height of the rail?"

"That has nothing to do with it."

"I ask you, what is to be the height of the flanch of the wheel?"

"One and a quarter inch."

"Then if the rail bends to the extent of an inch and a quarter, it will go off the rail?"

"It cannot bend; I know it is so in practice."

"Did you ever see forty tons going at the rate of twelve miles an hour?"

"No, I have not seen it, but I have seen the engine running from eight to ten miles round a curve."

"What was the weight moved?"

"I think little, except the engine—the weight of the engine itself."

"Do you mean to tell us that no difference is to be made between those forty tons after the engine, and the engine itself?"

"It is scarcely worth notice."

"Then, though the engine might run round, and follow the turn, do you mean to say that the weight after it would not pass off?"

"I have stated that I never saw such a weight move at that velocity; but I could see at Killingworth that the weight was following the engines, and it is a very sharp curve; I believe they came down very frequently at the velocity of fully ten miles an hour;

it is a sharper curve there than I should recommend to be put on any railroad."

"Have you known a stagecoach overturn when making not a very sharp curve, when going very fast?"

"That is a different thing; it is top-heavy."

"Do you mean to say, none of your wagons will be top-heavy?"

"They will not; perhaps they may get a good deal of cotton upon them; but I should construct the carriages so that they should not be top-heavy."

In such competent fashion Stephenson answered these questions, and many others, but the general disbelief in his claims, together with the opposition of the land-owners and canal companies, was sufficient to defeat the bill for the Liverpool and Manchester Railway in Parliament at that session. However, the interests of trade demanded a new line of communication between those two business centres and the promoters of a railroad continued their work. Again a bill was presented to Parliament, and again orators attacked it. A member of the House of Commons made an impassioned speech. "What," he said, "was to be done with all those who had advanced money in making and repairing turnpike-roads? What with those who may still wish to travel in their own or hired carriages, after the fashion of their forefathers? What was to become of coach-makers and harness-makers, coach-masters and

coachmen, inn-keepers, horse-breeders, and horse-dealers? Was the House aware of the smoke and the noise, the hiss and the whirl, which locomotive engines, passing at the rate of ten or twelve miles an hour would occasion? Neither the cattle ploughing in the fields or grazing in the meadows could behold them without dismay. . . . Iron would be raised in price 100 per cent or, more probably, exhausted altogether! It would be the greatest nuisance, the most complete disturbance of quiet and comfort in all parts of the kingdom, that the ingenuity of man could invent!"

The bill passed Parliament, however, in spite of this oratory, and Stephenson began to construct the railway. In this work he undertook and accomplished a remarkable engineering feat, the building of a part of the line over Chat Moss, a wide stretch of waste land and bogs that seemed impassable. Four miles of Chat Moss had to be traversed and to do this embankments were constructed and the bogs drained and filled in. Most engineers thought that a road could not be laid here, but Stephenson achieved it. In addition to the work at Chat Moss, other parts of the line were remarkable feats of engineering for that day; there were sixty-three bridges over and under the road at different places; the great Sankey viaduct, of nine arches of fifty feet span, rose to a height of nearly seventy feet above the Sankey canal; a tunnel was made under part of Liverpool, and the Olive Mount excavation was a deep cutting

through solid sandstone rock for a distance of two miles.

Every detail of this gigantic work was attended to by Stephenson, who labored unremittingly and was always confident of success. Once someone spoke to him of the genius of Napoleon in achieving his aims. "Tush!" exclaimed the engineer, "don't speak to me about Napoleon! Give me men, money, and materials, and I will do what Napoleon couldn't do—drive a railroad from Liverpool to Manchester over Chat Moss!"

He did this, and all England marveled at his accomplishment.

§ V

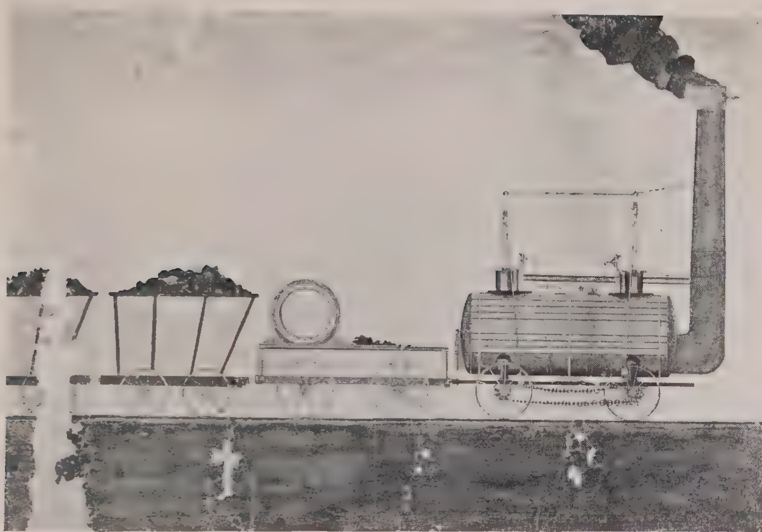
THE BUILDING OF THE "ROCKET"

A firm road had been constructed across Chat Moss and the tunnel at Liverpool had been finished, but the directors of the company had not yet decided what kind of tractive power should be used in working the railway. As they expected a large amount of traffic they gave over the idea of employing horse power, although that old-fashioned and conservative method had still some strong advocates. Some mechanical agency should be adopted; the question was whether that agency should be fixed or locomotive engines.

The discussion on this subject of tractive power

brought many novel schemes to the consideration of the directors. Some promoters suggested plans for working the wagons by water power, others proposed hydrogen, and others carbonic acid gas. There were advocates of the employment of atmospheric pressure. Thomas Gray, of Nottingham, urged his plan of a greased road with cog rails; and Vignolles and Ericsson recommended the use of a central friction rail, against which two horizontal rollers under the locomotive, pressing upon the sides of this rail, were to afford the means of ascending the inclined planes. Stephenson declared himself decidedly in favor of smooth rails and locomotive engines, which he was confident would be the most economical and convenient method of transportation.

The directors engaged various celebrated engineers to make reports on the advantages and disadvantages of the locomotive engine; and most of these reports recommended the use of fixed rather than locomotive engines. Still Stephenson persisted in urging the latter method and promised that, if opportunity were given him, he would build an engine that would answer all requirements and prove capable of pulling heavy loads with speed, regularity, and safety. This persistence on his part had great weight with the directors, the more that they had seen him construct a road across Chat Moss, a work that had been declared impracticable by many engineers of the highest reputation. As he had succeeded there, he might also succeed with the locomotive.



THE KILLINGWORTH LOCOMOTIVE

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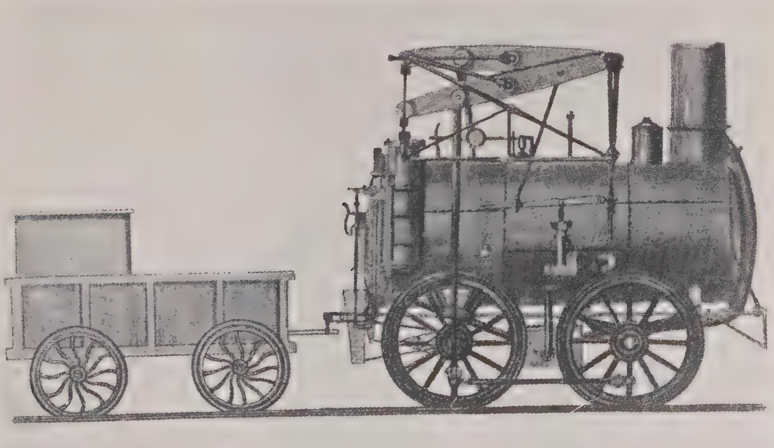


THE STOURBRIDGE LION IMPORTED FROM ENGLAND, 1829

Therefore, as an inducement to inventors to build locomotives, the directors offered a prize of £500 for the best locomotive engine that, on a certain day, should be produced on the railway and perform certain specified conditions in the most satisfactory manner.

These conditions were as follows:

1. The engine must effectually consume its own smoke.

2. The engine, if of six tons weight, must be able to draw after it, day by day, twenty tons weight (including the tender and watertank) at ten miles an hour, with a pressure of steam on the boiler not exceeding fifty pounds to the square inch.

3. The boiler must have two safety valves, neither of which must be fastened down, and one of them must be completely out of the control of the engineman.

4. The engine and boiler must be supported on springs, and rest on six wheels, the height of the whole not exceeding fifteen feet to the top of the chimney.

5. The engine, with water, must not weigh more than six tons; but an engine of less weight would be preferred on its drawing a proportionate load behind it; if of only four and a half tons, then it might be put on only four wheels. The Company to be at liberty to test the boiler, etc., by a pressure of one hundred and fifty pounds to the square inch.

6. A mercurial gauge must be affixed to the ma-

chine, showing the steam pressure above forty-five pounds per square inch.

7. The engine must be delivered, complete and ready for trial, at the Liverpool end of the railway, not later than the first of October, 1829.

8. The price of the engine must not exceed £550.

As soon as this prize was offered George Stephenson set to work to capture it. His son Robert had been for some time engaged in mining in South America; in 1827 he had returned to England to take charge of the locomotive factory at Newcastle that had been established by his father and Edward Pease. There he proved himself a remarkably capable engineer and made many valuable additions to the construction of locomotives. With his father and other skilled workmen at the Newcastle plant he now built the engine, known as the "Rocket," for the Liverpool and Manchester competition.

The chief improvement over other locomotives that was made in the "Rocket" was the use of the multitubular boiler. Of this Robert Stephenson later said: "After the opening of the Stockton and Darlington, and before that of the Liverpool and Manchester Railway, my father directed his attention to various methods of increasing the evaporative power of the boiler of the locomotive engine. Amongst other attempts, he introduced tubes (as had before been done in other engines), small tubes containing water, by which the heating surface was ma-

terially increased. Two engines with such tubes were constructed for the St. Etienne Railway, in France, which was in process of construction in the year 1828; but the expedient was not successful—the tubes became furred with deposit, and burned out.

"Other engines, with boilers of a variety of construction, were made, all having in view the increase of the heating surface, as it then became obvious to my father that the speed of the engine could not be increased without increasing the evaporative power of the boiler. Increase of surface was in some cases obtained by inserting two tubes, each containing a separate fire, into the boiler; in other cases the same result was obtained by returning the same tube through the boiler; but it was not until he was engaged in making some experiments, during the progress of the Liverpool and Manchester Railway, in conjunction with Mr. Henry Booth, the well-known secretary of the company, that any decided movement in this direction was effected, and that the present multitubular boiler assumed a practicable shape. . . .

"At this stage of the locomotive engine, we have in the multitubular boiler the only important principle of construction introduced, in addition to those which my father had brought to bear at a very early age (between 1815 and 1821) on the Killingworth Colliery Railway. In the 'Rocket' engine, the power of generating steam was prodigiously increased by the adoption of the multitubular system. Its ef-

ficiency was further augmented by narrowing the orifice by which the waste steam escaped into the chimney; for by this means the velocity of the air in the chimney—or, in other words, the draught of the fire—was increased to an extent that far surpassed the expectations even of those who had been the authors of the combination."

The "Rocket" was constructed in the following fashion. The boiler was made cylindrical with flat ends, six feet in length, and three feet four inches in diameter. The upper half of the boiler was used as a reservoir for the steam and the lower half was filled with water. Through the lower part, twenty-five copper tubes of three inches diameter extended, which were open to the fire-box at one end and to the chimney at the other. The fire-box, or furnace, which was two feet wide and three feet high, was attached immediately behind the boiler, and was also surrounded with water. The cylinders of the engine were placed on each side of the boiler, in an oblique position, one end being nearly level with the top of the boiler at its after end, and the other pointing towards the centre of the foremost or driving pair of wheels, with which the connection was made from the piston-rod to a pin on the outside of the wheel. The engine, together with its load of water, weighed only four tons and a quarter, and was supported on four wheels, which were not coupled. The tender had four wheels also, and was similar in shape to a wagon;

the front part of it held the fuel and the rear part a watercask.

When the "Rocket" was finished it was tried out on the Killingworth Railway and the new boiler construction was found to work perfectly. The engine was then sent by wagon to Carlisle and shipped from there to Liverpool.

The competition for the directors' prize was exciting the greatest interest, not only among engineers, inventors and mechanics but among the public generally, who felt that if this new method of transporting freight and passengers should be successful it would prove of immense benefit to the country at large. Crowds flocked to Rainhill, where the contest was to be held. Four engines were entered for the prize: the "Novelty," built by Braithwaite and Ericsson; the "Sans-pareil," built by Timothy Hackworth; the "Rocket," built by Stephenson and Booth; and Burstall's "Perseverance." Another engine, the "Cycloped," which was worked by a horse in a frame, had been entered, but was not allowed to compete. In addition to these, other engines were being constructed in different parts of the country, but could not be completed in time for the competition.

The place chosen for the contest was a level stretch of railroad about two miles in length. Each engine was to make twenty trips in the course of the day at a speed not less than ten miles an hour. To avoid

confusion it was decided that the engines should be tried on different days.

The date fixed for the competition was October first, but this was changed to October sixth, and on that morning thousands of spectators journeyed to Rainhill, where a stand had been provided for the ladies and rows of carriages lined the road.

The "Rocket" was the first engine ready and the judges ordered it to make an experimental trip. On that day it ran about twelve miles in about fifty-three minutes. The "Novelty" next was tried. This was a very light locomotive, weighing only a little over three tons, of compact appearance, carrying water and fuel on the same wheels as the engine. Some question arose as to the load this locomotive should carry, and it only made an exhibition trip, during which it occasionally moved at the rate of twenty-four miles an hour. An exhibition trip was also made by the "Sans-pareil," a locomotive similar in pattern to those in use on the Stockton and Darlington Railway.

The competition was postponed to the following day. Then the bellows employed to create the blast in the "Novelty" would not work and that locomotive was withdrawn from the day's contest. There was also trouble with the boiler of the "Sans-pareil" and its builder was granted time to repair it. The crowd of spectators were disappointed and Stephenson, to entertain them, brought out the "Rocket," and, attaching it to a coach holding thirty passen-

gers, ran it along the line at a rate of from twenty-four to thirty miles an hour.

On October eighth the "Rocket" made her trial run. The engine was taken to the end of the line, the fire-box was filled with coke, the fire lighted, and the steam raised until it lifted the safety-valve to a pressure of fifty pounds to the square inch. The engine then set out, drawing about thirteen tons weight in wagons, and made ten round-trips along the two miles of road. The maximum velocity attained was twenty-nine miles an hour, and the average speed fifteen miles an hour. The spectators were astonished and delighted, and the directors of the company felt more than satisfied with Stephenson's achievement.

Neither the "Novelty" nor the "Sans-pareil" was ready on that day, and when they were tested later neither was found so reliable as the "Rocket." The fourth engine, Burstall's "Perseverance," could not move at more than five or six miles an hour. The "Rocket" was the only locomotive that had fulfilled all the stipulated conditions, and its builders were accordingly awarded the prize.

§ VI

THE OPENING OF THE LIVERPOOL AND MANCHESTER RAILWAY

With the successful performance of the "Rocket" work on the road between Liverpool and Manchester

was pushed forward with fresh vigor and enthusiasm. As Stephenson had promised, a single line was completed by the first of January, 1830, and the "Rocket," pulling a coach full of directors, engineers and friends, journeyed over the entire length of Chat Moss and also over the greater portion of the road between the two cities. At each trial of the locomotive's powers it did better, and on an exhibition trip in June, 1830 the "Rocket" drew a train of two carriages with about forty persons and seven loaded wagons from Liverpool to Manchester in two hours and one minute and made the return journey in an hour and a half.

The public opening of the railway took place on September 15, 1830. George and Robert Stephenson had built eight locomotives for the road's service. To keep the line clear, especially in Liverpool, numbers of soldiers and constables were employed. The completion of this great work, which had attracted the attention of all England, was regarded as an event of national importance, and there were present the Duke of Wellington, who was Prime Minister, Sir Robert Peel, a secretary of state, Mr. Huskisson, a member of the House of Commons from Liverpool, and many other distinguished guests. The "Northumbrian" engine, driven by George Stephenson, led the procession, followed by the "Phoenix," driven by Robert Stephenson, the "North Star," driven by Robert Stephenson, senior (brother of George), and five other locomotives. About six hundred passen-

gers rode in the trains drawn by the eight engines. Thousands of spectators cheered as the trains moved at a rate of twenty-four miles an hour through the ravine of Olive Mount, upon the Sutton incline, over the Sankey viaduct.

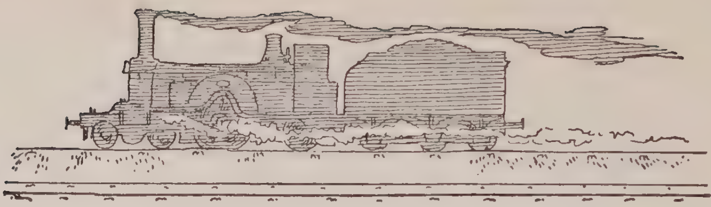
At Parkside, seventeen miles out from Liverpool, the engines stopped to take in water. The "Northumbrian," with the carriage containing the Duke of Wellington, drew up on one line so that the other trains might pass in review on the other line before the Prime Minister and his party. Mr. Huskisson alighted and stepped on to the opposite track, along which the "Rocket" was coming up at considerable speed. The Duke of Wellington held out his hand to greet Mr. Huskisson and the latter turned to grasp it. There were shouts: "Get in, get in!" Mr. Huskisson, much confused, tried to get round the open door of the carriage, which projected over the opposite rail, but was struck by the "Rocket," and his leg, doubled across the rail, was crushed. He was carried to a house, where he died from the injuries.

This accident cast a gloom over the proceedings and the Duke of Wellington and Sir Robert Peel wished the procession to return immediately to Liverpool. When it was pointed out to them, however, that a great many spectators were waiting to see the trains arrive at Manchester and that if they did not complete the journey the railway would be jeopardized they consented to continue on the agreement that there should be no public festivities.

The journey was therefore accomplished, and the Liverpool and Manchester Railway was acclaimed a complete success. It commenced regular service as a carrier of passengers and merchandise, with great profit to its owners. In one respect, however, the estimates of the directors were proved incorrect; they had based their calculations almost altogether on the traffic in such articles as coal, cotton and timber, relying little upon passengers, whereas what actually happened was that the receipts from the conveyance of passengers far exceeded those from the conveyance of merchandise, and the latter for some time continued to be a subordinate part of the railway's business. Soon after the line was opened the trains were carrying an average of about 1200 passengers a day, and in the first eighteen months of its use some 700,000 persons were conveyed over the road without an accident. The journey from Liverpool to Manchester had taken four hours by coach, by the railway train it was usually made in an hour and a half.

The speed that was sometimes attained, twenty-five miles an hour, was considered amazing, yet passengers found the ride as smooth as over the best turnpikes of Mr. Macadam. Two Edinburgh engineers, reporting on the road, declared that even when travelling at the highest speed they "could observe the passengers, among whom were a good many ladies, talking to gentlemen with the utmost *sang froid.*"

The opening of the railway had many beneficial results. There was a large reduction in the price of coal and in the cost of carrying general merchandise. Liverpool men could travel to Manchester in the morning, do a day's business there, and return home the same evening. Also—and this refuted the arguments of those who had opposed the railroad—the land adjoining the line immediately rose in value, and instead of people being frightened away by the noise, fire and smoke of the engines they were eager to build in the adjoining territory, and even the waste stretches of Chat Moss, that had been barren and unproductive, were improved and cultivated and made into flourishing farms.



3

DEVELOPMENT OF RAILWAYS

THE inauguration of the Liverpool and Manchester Railway in 1830 marked the beginning of a new era in the history of transportation. Many inventors contributed to this accomplishment, but the palm of glory belongs to George Stephenson, who had shown himself preeminent both as an engineer in constructing railroad lines and as a builder of efficient locomotives. He had won out over all opposition and had realized his cherished dream of seeing the day when railways should "become the Great Highway for the king and all his subjects."

The legislators of England were at the time devoting their attention to the improvement of the turnpike roads, for which they were voting large sums of money to Mr. Macadam for his new process, and were not much interested in the novel method of transportation by railway. It fell upon private individuals therefore to construct new lines and the building of these roads was undertaken by joint-stock associations of proprietors, employing their own money, as had been the case with the Stockton

and Darlington, and Liverpool and Manchester Companies.

While Stephenson was constructing the latter railway he sent some of his assistants to build a short line, about six miles in length, between Canterbury and Whitstable. This road was opened for traffic in 1830, and was worked partly by fixed engines and partly by locomotives. The most important railways, however, built after the inauguration of the Liverpool and Manchester road were in connection with it and were located mainly in Lancashire. There was a branch from Bolton to Leigh, and another from Leigh to Kenyon; lines to Wigan on the north and to Runcorn Gap and Warrington on the south. Other projected roads were a cross-country railway from Manchester to Leeds, which would traverse the populous manufacturing districts of East Lancashire and West Yorkshire and connect the chief towns of those large northern counties with each other, a line from Manchester to Birmingham, which was called the Grand Junction Railway, and a road from Birmingham to London. Of most of these new lines George Stephenson was appointed engineer, and on them he worked, frequently in association with his son Robert.

These railways met with much opposition from landowners and farmers, who objected to having "fire horses" run through their quiet fields to the detriment of their cattle and to the spoliation of the beauty of country homes. The railway from London

to Birmingham, as it was originally planned, was to have had its London terminus at Maiden Lane, King's Cross, to pass through Cashiobury and Grove Parks, the country seats of Lord Essex and Lord Clarendon, and along the Hemel Hempstead and Little Goddesden valleys in Hertfordshire. This route excited great opposition from Lady Bridgewater and her trustees, Lord Essex and Sir Astley Cooper, as well as from the Grand Junction Canal Company, and through their influence the landowners of Hertfordshire and Buckinghamshire were organized against the railway. Moreover the road, as planned, would pass close to the town of Northampton, and the citizens rose in protest. So much antagonism was caused that the engineers altered their route, changed the London terminus to a large piece of open land adjoining the Regent's Canal, deflected the line from the parks of Lord Essex and Lord Clarendon, and avoided the Hemel Hempstead and Goddesden valleys; although this put them to the inconvenience and extra expense of building a tunnel a mile in length at Watford. To satisfy the people of Northampton the road was also altered there by the construction of the Kilsby Tunnel, a costly feat of engineering. This tunnel was built under almost insuperable difficulties by Robert Stephenson, and the railway of one hundred and twelve miles was opened for traffic in 1838.

As people gradually became accustomed to seeing the railways at work and appreciated their advan-

tages in simplifying commerce and travel they gave over their opposition and even advocated them. Thus not many years after the construction of the Kilsby Tunnel, which was built in order to avoid the neighborhood of Northampton, the citizens of that town clamored for a railway and would not be content until a special branch line was laid for their convenience. Still, however, country gentlemen opposed them. Mr. Berkeley, a Member of Parliament for Cheltenham, declared in a public speech: "Nothing is more distasteful to me than to hear the echo of our hills reverberating with the noise of hissing railroad engines running through the heart of our hunting country, and destroying that noble sport to which I have been accustomed from my childhood." Another gentleman, Colonel Sibthorpe, announced that he "would rather meet a highwayman, or see a burglar on his premises, than an engineer; he should be much more safe, and of the two classes he thought the former more respectable!"

This point of view was that of the old entrenched aristocrat, who has almost always been in opposition to new ideas. Against it may be placed the view of a more enlightened type of man: said the famous Dr. Arnold, Headmaster of Rugby, as he watched a railway train steam across the field: "I rejoice to see it, and think that feudality is gone forever. It is so great a blessing to think that any one evil is really extinct."

The opening of the lines between London, Birm-

ingham, Liverpool and Manchester soon showed the fallacy of most of the arguments used against the railway. The owners of the canals were surprised to find that in spite of the immense business done by the railways their own traffic and receipts continued to increase most satisfactorily. Cattle-owners found the price of horse-flesh rising to their advantage, and the number of coaches running to and from the new railway-stations gave employment to more horses than under the stagecoach system. Instead of injuring the business of London, as some had predicted, the railways greatly improved it; thousands who had never been able to visit the metropolis came there by train, fresh meat and vegetables were supplied from the country, and these, as well as coal and other important commodities, cost less to the populace.

In the country districts the farmers were able to buy their coal, lime, and manure for less than they had before and found the markets for their produce much more accessible. Their cattle were not frightened by the engines nor were their buildings burned by flying sparks. Landlords discovered that they could obtain higher rents for property near a railway and petitioned the companies to build new sidings and stations. It was considered an advantage to be able to advertise real estate offered for sale as being "near a railway station."

As to the matter of travel, passengers found that they could save time and money by riding by train

rather than by stagecoach. The railway carriages were very much more comfortable than the stagecoaches. They were also safer; in the first eight years of the Liverpool and Manchester Railway no fewer than five million passengers were carried with only two casualties, and during that same period there were an immensely larger number of stagecoach casualties. The railways were democratic, and therefore many of the aristocrats preferred to travel in their private coach or family chariot rather than in a train with shopkeepers and farmers. Yet when they did try the railway they found it so much more comfortable and convenient than their own carriages that they gradually adopted it. In 1842 Queen Victoria began to make use of the railway on her trips from London to Windsor and the opposition of the nobility to this democratic mode of travel perforce ceased.

4

THE MIDLAND RAILWAY

THE MIDLAND RAILWAY, which is one of the most important systems of England, resulted, in part at least, from the rivalry between the coalfields of Leicestershire and Derbyshire. The bursting of the Charnwood Forest Canal in 1799 had deprived the mines of Leicestershire of almost all suitable communications, the owners of the collieries had considered many propositions for getting their coals to market, and had engaged Robert Stephenson to construct the Leicester and Swannington Railway. The first section of this line, from Leicester to Bagworth, was opened in 1832, with the ceremonies that were then customary on the inauguration of a new railway, the firing of cannon, the ringing of bells and the playing of bands. A mile from the start was the Glenfield Tunnel and in the middle of this excavation the chimney of the "Comet" locomotive struck the roof and broke, covering the passengers in the open carriages with soot. One other accident occurred, the account speaking of a "woman being ridden over alongside the railway by a cavalier who was trying to keep up with the

train." Otherwise the day was a success for the engineers, the passengers and the onlookers.

This step to improve transportation in the Leicestershire coalfields roused the competitive spirit of the coal-owners of Derbyshire, and they organized to build the Midland Counties Railway. This line was constructed in three sections; the first, which ran from Derby to Nottingham, was opened in 1839, the second, from Leicester to Trent Junction, in 1840, and the third, from Leicester to Rugby, in the same year. It was then possible to travel from Derby to London by two routes, either by way of Birmingham, over the Derby and Birmingham and the London and Birmingham lines, or by the Midland Counties and the London and Birmingham. This choice of roads promptly led to a battle for traffic between the feeders of the main line to London.

These new railways advertised themselves by popular excursions, when tickets were sold at half-price. These excursions made a great stir and many took advantage of them. The "Leicester Journal" of August 28, 1840, gives this account of a popular trip from Nottingham to Leicester: "The engines were overloaded, and the progress was slow. There were about 2400 persons. A special engine, with all proper means and appliances in case of accidents, was sent off to reconnoitre, but did not return. At length, about 12.30, when the excitement had almost worn itself out of long endurance, a white flag, the signal of security, was seen from the station waving in the

air. The enormous train of nearly seventy carriages passed majestically in review before the astonished spectators. It was indeed a wonderful scene. Grand! magnificent! sublime! were the terms which gave vent to the feelings as in countless succession the animated mass rushed into view. It was in truth a moving city, with banners and music and accompaniments of all the material of high excitement to enhance its efficacy."

Another line, the North Midland Railway, made Derby its terminus in 1840. This road ran from Derby to Leeds and was built by George Stephenson, who added to his list of achievements by constructing an elliptically-sectioned tunnel at Ambergate in order to overcome the sliding of a bank of shale. The North Midland increased the competition between the Midland Counties and the Derby and Birmingham Junction roads, and each of the latter reduced its fares by 75 per cent in the fight for business. Such competition was ruinous, and to protect the shareholders the North Midland and the two other lines were amalgamated in 1844 under the name of the Midland Railway Company.

This railroad system was now well established in the Midlands of England and did a flourishing business by connecting the colliery and manufacturing districts that centred around Birmingham, Derby and Leeds with the metropolis of London. The company now adopted a policy of expansion and built a line from Nottingham to Lincoln in 1845 and a

branch to Peterborough in 1848. In constructing the latter road the route lay across country that belonged to Lord Harborough, a conservative, fox-hunting nobleman, who also owned a canal, which he thought would be injured by the railway. When the surveyors entered this nobleman's property they were driven off by his gamekeepers; the surveyors rounded up a band of adherents and marched on the grounds again; a pitched battle followed until police arrived, when both parties threw their weapons away and indulged in a hand-to-hand scrimmage. More combats ensued, in which the gamekeepers came out victorious over the surveyors, and the matter was decided by Lord Harborough granting the company the right to build a tunnel under his land. The tunnel unfortunately fell in, and the engineers proposed to make a cutting. The nobleman forbade that, and when an alternative route was proposed through another part of his property he forbade that also. After a great deal of controversy an agreement was arrived at, and the road was completed by building what was known as "Lord Harborough's Curve."

The centre of England was now well knit together by the Midland Railway. In the west a railroad was opened from Birmingham to Gloucester in 1840, the Great Western Railway inaugurated a line to Bristol in 1841, and a few years later Bristol was joined by a road to Gloucester. The Midland and the Great Western both desired to own the lines from Birmingham to Gloucester and from Gloucester to Bristol,

and each made offers to the proprietors of those roads. The Midland's offer was the better and was accepted, and in 1846 Gloucester and Bristol became part of the Midland's network.

On the north this ambitious railroad system extended its reach by leasing a line that ran from Skipton to Lancaster and then by constructing a branch from Settle on this road to Carlisle. One important town yet remained to be linked up: Manchester was not touched by the Midland, and Manchester, with its thriving trade, was an exceedingly valuable terminus.

To Manchester there was a short road, the High Peak Railway, that had been built with heavy gradients through the Derbyshire Hills, and a line from Manchester to Crewe. This latter line, wanting an outlet to the south, took over the High Peak, and agreed to connect with the Midland at Ambergate. Before this junction of interests was made, however, rivals of the Midland came into the field; the London and Birmingham, the Grand Junction, which ran from Birmingham to Manchester, and the Manchester and Crewe road combined forces and organized the system which became known as the London and North Western. This kept the Midland from Manchester, and as that company was determined to reach that town the directors decided to build a line of their own. This they did, although their route lay through the Peak Forest country, which presented many difficulties, the chief of which was the boring

through the Peak with a tunnel almost two miles long. A large viaduct built of brick at Bagsworth was ruined by a landslide and had to be replaced by one of wood. The road was successfully completed, however, and the Midland linked Rugby to Manchester.

With so many branches, north, east and west, the Midland now wanted to do away with its dependence on the Great Northern Railway and the London and North Western for connection with London. Those roads carried the Midland's traffic, but gave preference to their own. So the Midland obtained permission from Parliament to construct a line over the territory from Bedford to London. This route lay through Luton, St. Albans and Hendon to a metropolitan terminus at St. Pancras, where the Midland built its London station near the stations of its great rivals, the London and North Western and the Great Northern Railways.

In such fashion the needs of the coalfields led to the weaving of shining rails over central England.

5

THE BATTLE OF THE GAUGES

THE gauge of the first English railways had been the width of the tramroads in use in the colliery districts. George Stephenson had adopted this gauge not on any scientific theory but simply because it was the gauge in common use on the coal roads; once adopted, he believed that that width should be adhered to in all the railways built in order to obtain such uniformity as would allow perfect communication between the various lines of the country. Therefore the roads constructed by Stephenson and his assistants were built on what was called the Liverpool and Manchester or narrow gauge, which was 4 feet 8½ inches.

Some business men of Bristol, the flourishing seaport on the west coast of England, decided in 1833 to connect their city with London by railroad. The engineer they engaged was Mr. Brunel, a very ingenious inventor who liked to do things on a large scale. Unlike George Stephenson he did not think there was any need of having all the railways of the

country use a standard gauge, since he assumed that the country would be divided into railway districts, which would have little intercourse with each other. On the road he planned—the Great Western—he intended to employ larger locomotives than those yet built and attain greater speed, and therefore he constructed his railway on a 7 foot or broad gauge.

The directors of the Great Western backed their engineer and Brunel built his broad gauge line from London to Bristol. This was opened to traffic in 1841, the Bristol and Exeter Railway was shortly thereafter constructed, the South Devon to Plymouth was inaugurated in 1846, and the Cornwall Railway to Truro in 1859. These lines were presently amalgamated with the Great Western Railway, which thus came into control of a through broad gauge track from Paddington, its terminus in London, to Penzance at the southwest corner of England.

On the section from London to Bristol there were constructed the Maidenhead Bridge and the Box Tunnel, two notable feats of engineering. The bridge is one of the finest pieces of brickwork in England. Many critics thought the spring of the main spans insufficient to make the arches secure, but the bridge, when used, proved a triumph for its builders. The Box Tunnel, nearly two miles in length, was another triumph for Brunel and his assistants, and showed that they were as capable in boring through the earth as in stringing bridges over it.

So long as the Great Western Railway was con-

cerned solely in carrying traffic on its own tracks no difficulty arose over the question of gauges, but when presently narrow gauge lines met the Great Western at various points and passengers and goods had to be transferred from one set of carriages to another so much inconvenience resulted that the public began to demand some remedy for the situation. The Birmingham manufacturers, experiencing great delay and loss in traffic from the break of gauge at Gloucester, held a public meeting in 1844 and protested against what they termed "a commercial evil of the first magnitude." Thus began what was popularly known as the "Battle of the Gauges."

A commission was appointed to study the subject of the two gauges. After taking much evidence, the commissioners voiced these conclusions: As to the safety, accommodation, and convenience of passengers, no decided preference was due to either gauge, but it appeared that on the broad gauge the motion was generally more easy at high rates of speed. In respect to speed, it was considered that the advantages were with the broad gauge, but it was thought that the travelling public would be endangered in employing the greater capabilities of the broad gauge much beyond their present use, except on roads more substantially and perfectly built than those then existing. As regards the transport of goods, it was held that the narrow gauge possessed the greater convenience and was better suited to the general traffic of the country. The broad gauge involved the greater

outlay and there appeared, neither in the maintenance of way nor in cost of locomotive power, nor in other expenses, no adequate reduction to compensate for the additional first cost. The commissioners therefore recommended that, if it were deemed advisable to have uniformity, the broad should be altered to the narrow gauge, especially since the extent of the former type of road was only 274 miles and of the latter not less than 1901 miles.

The commission's report was regarded as a victory for the narrow gauge, but the Great Western did not give up the battle and in 1846 received permission to build a broad gauge line through South Wales and another from a station on the Oxford line to Birmingham. Then Parliament passed the Gauges Act, which made it illegal thenceforth "to construct any railway for the conveyance of passengers on any other gauge than 4 feet 8½ inches in Great Britain," although exceptions were made in the case of a future connection between the South Wales Railway and Bristol, the Oxford, Rugby and Wolverhampton Railway, and any connection the Great Western should construct south of its main line.

Parliament favored the narrow gauge party again when in 1848 it ordered the introduction of mixed broad and narrow gauges on the Oxford-Birmingham line. The Great Western obeyed by laying a third rail for narrow carriages and using the outside, or platform, rail for both gauges. Other mixed lines followed, and in 1861 narrow gauge trains com-

menced running from the Great Western station in London to Birmingham.

The Great Western was a road of many remarkable achievements, among which was the building of powerful broad gauge locomotives by the engineer Gooch. The first of this series, called the "Great Western," was constructed in thirteen weeks; it made a trip from Paddington Station in London to Swindon and back with a train of fourteen carriages at an average speed of fifty-seven miles an hour, and another from Paddington to Exeter, a distance of almost 200 miles, at the rate of fifty-three miles an hour. Later an express ran regularly from Paddington to Slough, eighteen miles, in fifteen and one-half minutes, or over seventy miles an hour. The Great Western broad gauge engines were splendid locomotives.

Another most interesting achievement was the construction of the South Devon Railway from Exeter to Plymouth. From Exeter the line ran south along the river Exe for some ten miles, then followed the coast another ten miles to Teignmouth, thence along the estuary of the Teign five miles to Newton Abbot, and from there reached west the thirty miles or so to Plymouth. As far as Teignmouth the line was practically level, although it required the building of numerous sea-walls and embankments and considerable tunnelling. What made the road notable was the fact that Brunel adopted the atmospheric system to propel the trains.

The line to Newton Abbot was opened in 1847. A fixed iron pipe with a longitudinal slit at the top closed by a leather valve ran along the track, and one of the railway carriages was furnished with an arm that projected downwards and passed through the slit into the tube, where it terminated in a piston. At the ends of the line were placed pumping engines to exhaust the air from the tube on that side of the piston that faced the direction in which the train was to move. The vacuum that was thus made caused the air on the opposite side of the piston to exert a pressure of almost fourteen pounds to the square inch, and the impetus transmitted by the arm to the railway carriage was sufficient to move a light train at a speed of seventy miles an hour. A vacuum was maintained in the tube by the flexible strip of leather that permitted the movement of the arm but only admitted a minimum of air.

This novel system was successfully demonstrated on the new piece of road from Teignmouth to Newton Abbot in January, 1848, and at a general meeting of the company in February the chairman stated: "The atmospheric had proved so successful that the locomotive had been entirely withdrawn from the line between Newton and Exeter. Out of 884 trains which had then been run, 790 had either gained time or performed the journey in the same time."

Yet this clever device of Brunel's was shortly afterwards discarded in favor of the locomotive, because it was found that the longitudinal valve upon

which the maintenance of a vacuum depended had so deteriorated in a year's use that it required repairing, which would involve a cost of £1600 per mile of track. Such a change to locomotives would have been required in any event when the South Devon Railway amalgamated with the Great Western and through trains, without any break in propulsive system, were run from Paddington to Plymouth.

Brunel was also the designer of the Saltash suspension bridge which crosses the Tamar estuary on the Cornwall Railway from Falmouth to Plymouth, opened in 1859. The two main spans of this bridge were each 455 feet in length, almost as long as the spans of the tubular bridge built by Robert Stephenson across the Menai Straits. These were supported by three masonry piers, two of which stood in shallow water; the third was built in the middle of the stream, which necessitated piercing down through deep mud to hard rock by means of a circular caisson. The trusses for the main spans were a combination of arch and suspension chains, which were put on iron pontoons, warped into position over the pier foundations, and lowered into place.

The South Wales Railway, which joins the Great Western at Bristol, was directly connected with London when the first train passed through the Severn Tunnel in 1885. This is the longest tunnel in Great Britain and extends under the Severn for a distance of four and a half miles. Great were the difficulties of building it, due to the rush of fresh water from sub-

terranean springs and the flooding by salt water after a high tide. The laying of the bricks for the tunnel lining took fourteen years. The tremendous advantage to traffic justified the labor and expense.

Brunel's work for the Great Western Railway almost equalled in ability and industry that of George Stephenson on the roads of central England, but he had been wrong in supposing that his lines could successfully employ the broad gauge while the rest of the country preferred the narrow. Gradually the Great Western changed its branch lines from broad to narrow gauge and on May 20, 1892 the last broad gauge train left Paddington for Penzance. Stephenson's gauge, that of the colliery tramroads, had won the battle, and the gauge he adopted for his first railway train, 4 feet 8 ½ inches, is the standard gauge of most of the railroads of the world.

6

SOME GREAT ROADS

THE history of railroads in England is indissolubly linked with the names of George Stephenson and his son Robert. What the father originated the son carried on; from the opening of the Liverpool and Manchester Railway they worked together on many great engineering enterprises and in the improvement of locomotives. Robert Stephenson showed the admirable use he had made of his father's training when he built the celebrated tubular bridge over the Menai Straits and the even more important High Level Bridge at Newcastle, one of the most picturesque and striking triumphs of railroad engineering.

Newcastle, near the east coast of England, was on the direct route from London to Edinburgh, and it was early proposed to build a railroad through the northeastern section of the country that would parallel in a general way the Great North Road of stagecoach days. Various companies were organized, of which two presently dominated the situation. George Hudson, known as the Railway King, constructed

one route from Euston Station in London to York over the Midland Railway and from York joined several disconnected lines together to carry his trains north to the Tyne. The sponsors of the rival company located their London terminal at King's Cross, which later became the metropolitan station for all those lines that were amalgamated into the London and North Eastern Railway.

While the financiers and the business heads of competing companies wrangled the engineers went ahead building the Great North Road of railway tracks. The bridge built by Robert Stephenson across the Tyne was opened in 1850 and in the same year was completed the Royal Border Bridge over the Tweed at Berwick, also constructed by Robert Stephenson. The next link in the East Coast route to the north was over the rails of the North British Railway, which stretched from the north bank of the Tweed to Edinburgh. On this North British division are two remarkable feats of engineering. The Forth Bridge, crossing the Firth of Forth, is one and one-half miles long, and until the building of the Quebec Bridge over the St. Lawrence River had the largest cantilever spans in the world. The Tay Bridge, that extends across the Firth of Tay into Dundee, is more than two miles in length and is carried on eighty-five spans. The capital of Scotland once reached, rivalry sprang up between the roads from London over the East and West Coast routes.

The East Coast route, called the Great Northern,

had the advantage in directness, the distance from King's Cross to Edinburgh was 395 miles, while it was 400 miles from Euston to Edinburgh. Running time was clipped first by the London and North Western on the West Coast route, then by the Great Northern on the East Coast. Competition waxed hot until the eastern line made a record run, reaching Edinburgh from London in 379 minutes and Aberdeen—distant 523½ miles from King's Cross—in 518 minutes, an average of more than a mile a minute over the 523½ miles. That record established, the East Coast line was content to rest on its laurels.

To avoid the costs of competition the companies that took part in building various sections of the Great North Road were consolidated, and under this system the Great Eastern, the Great Northern, the North Eastern, the North British, and the Great Central have been joined to form the London and North Eastern Railway.

There is a remarkable potency in picturesque names. A train that is simply designated by a number is an ordinary affair, but call that train the "Flying Scotsman" or the "Flying Dutchman" and immediately it takes on a new fascination. The "Flying Scotsman" of the London and North Eastern Railway—the most famous of English express trains—made its bow to the public on August 8, 1850. It ran from the station of York Road in London until the terminus at King's Cross was opened in 1852. By that time the bridges across the Tyne at New-

castle and the Tweed at the Border were completed and the "Flying Scotsman" carried passengers who paid first-class fare from the capital of England to the capital of Scotland in an hour less time than any competing line.

Service on this express train was constantly improved, third-class passenger coaches were added, and then first-and third-class dining-cars. Ever since the through road was opened the "Flying Scotsman" has made its run; from London and from Edinburgh the train leaves daily at the same hour and completes the journey of 395 miles in both directions in the same time, 8¼ hours.

The "Flying Dutchman" of the Great Western Railway was inaugurated in March, 1862, to run from Paddington in London to Exeter. The train proved so popular that the company lengthened its run to Plymouth and Falmouth, and afterwards to Penzance. The route and schedule of the "Dutchman" have experienced more alterations than those of the "Scotsman," but the "Flying Dutchman" is still the crack express from the metropolis to the West of England.

Pullman coaches, first introduced into England on the Midland Railway in 1872, were adopted by the London, Brighton and South Coast Railway for its "Pullman Limited Express" in 1888. This was the first entire Pullman train in England. At first it ran only on Sundays and carried only first-class passengers; to supply the demand third-class Pullman

coaches were included in the vestibuled train, and this express, rechristened the "Southern Belle," now runs twice daily in both directions and makes the trip between London and Brighton, a distance of 50.75 miles, in exactly one hour.

The popularity of the "Southern Belle" led to the installation of other Pullman expresses from London to seaside resorts; the "Thanet" of the South Eastern (now the Southern Railway) from London to Margate, Broadstairs and Ramsgate on the Isle of Thanet; the "Clacton" of the Great Eastern (now the London and North Eastern Railway) from London to Clacton on the East Coast. Of the same luxurious type is the "Harrogate Pullman Limited" on the London and North Eastern Railway, which connects London, Leeds, Harrogate, and Newcastle at an average running speed over the 279.6 miles of 48.6 miles an hour. Important points along the coast are also linked up by other Pullman expresses.

There is a cross-country train that runs from Penzance at the tip of Cornwall to Aberdeen in Scotland. The Great Western carries it by Plymouth to Banbury, the Great Central division of the London and North Eastern from Banbury by Rugby, Leicester, Nottingham, and Sheffield to Knottingley, the North Eastern division of the same railway to Berwick-on-Tweed. There the North British division picks it up for the section through Edinburgh to Dundee; to Aberdeen it is relayed by the Caledonian division of

the London, Midland and Scottish Railway. This train covers the 785 miles in 20 hours, 40 minutes.

So has the railroad in less than a century woven its web across Britain and justified George Stephenson's dreams.

PART TWO

NORTH AMERICA

1

TRAVEL IN THE COLONIES

THE first white settlers in North America travelled overland as did the Indians, on their own feet. Through forests they made their trails and over streams they improvised bridges of fallen trees. These paths were trodden by the heavy shoes of the colonists, widened by the passage of cattle, going to and returning from pasture, and improved to permit the passage of carts and other vehicles. In New England these primitive roads were called in the court-records "trodden paths," and one of the earliest, that between Boston and Plymouth, was officially established by the General Court in 1639. Paths or roads were ordered to be built "between towns and towns for horse and foot," and in this fashion settlements along the coast were linked with each other and with other towns as far west as Albany.

The settlers soon acquired horses, importing various breeds, and everyone who could afford it trav-

elled astride. Dignitaries maintained private coaches and so did some wealthy people. A visitor to Boston in 1740 wrote: "There are several families in Boston that keep a coach and a pair of horses, and some few drive with four horses; but for chaises and saddle-horses, considering the bulk of the place, they outdo London. They have some nimble, lively horses for the coach, but not any of that beautiful black breed so common in London. Their saddle-horses all pace naturally, and are generally counted sure-footed; but they are not kept in that fine order as in England. The common draught-horses used in carts about the town are very small and poor, and seldom have their fill of anything but labor. The country carts and wagons are generally drawn by oxen, from two to six according to the distance, or the burden they are laden with."

Travel by horse was convenient for short journeys, but not for long distances nor for the transportation of goods. Commerce was carried on by water, and to facilitate this most of the settlements were made on the coast or along rivers. As the country developed, however, trade could not be dependent altogether on waterways, and for inland commerce it became customary, as in Europe, to employ packhorses.

These packhorses were driven along Indian trails through the wilderness. By such a primitive route General Braddock had to march his troops when he set out in 1755 on his expedition into western Pennsylvania. For his use the trail was widened to a

wagon-road, and this road became the favorite route for the pioneers who crossed the Alleghany Mountains and settled southwestern Pennsylvania and western Virginia.

Over this route every autumn trains of packhorses carried furs and hides to Baltimore and the eastern markets and received in exchange the iron and steel and various commodities desired by the pioneers. The packhorse system became a regular common carrier business and all the important towns along the road had their packhorse companies.

On the track of the packhorse trains came the Conestoga wagon. This famous vehicle, which played an important part in the history of America, had a body shaped like a boat with a curved bottom, which kept the freight in place regardless of how the wagon might tilt. The body was usually painted gray or blue, with red sideboards. The rear end could be lifted. From the back was suspended a feed-trough for the horses, on one side was a tool-chest, and under the rear axle-tree hung a tar-bucket and water-pail. The tires of the wheels were very broad, sometimes almost a foot wide. Over the body of the wagon arched six or eight bows, those in the middle being lower than those at the ends. These bows were covered with a strong hempen top that was corded tightly at the sides and ends of the wagon, which could be loaded with freight right up to the top. The wagons carried from four to six tons each, or about a ton of weight for each horse.

The Conestoga breed of horses were fine, powerful animals, admirably adapted to their work. Their harness was of the best leather and frequently each horse except the saddle-horse wore a set of musical bells. Sometimes the driver walked alongside his team, sometimes he sat on the saddle-horse or on an adjustable seat called a lazy-board that hung at the wagon's side.

These Conestoga wagons were the great freight-carriers of pioneer days. There were three thousand at one time travelling back and forth between Philadelphia and western Pennsylvania towns. In the Revolution they rendered great service to the Continental army and during the War of 1812 transported arms and supplies to the troops on the frontier. From Pennsylvania the use of the Conestoga spread to every section of the country and under the new name of "prairie schooner" the Conestoga wagon carried the early tides of emigration across the plains and the Rocky Mountains to the Pacific Coast.

As roads improved stagecoaches after the English fashion were introduced into the colonies. A "stage-chaise" ran between Salem and Boston in 1767 and a "stage-chariot" between Boston and Marblehead in 1772. The first line of stages between New York and Philadelphia took about three days to make the journey. This advertisement was carried in the *Weekly Mercury* of March 8, 1759:

"Philadelphia Stage Waggon and New York Stage Boat perform their stages twice a week. John Butler

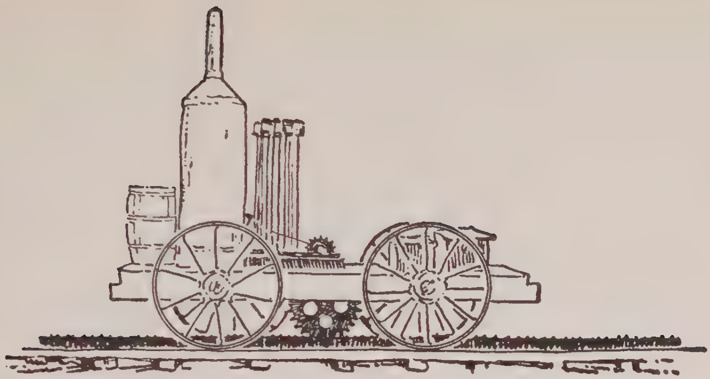
with his waggon sets out on Monday from his house at the sign of the 'Death of the Fox' in Strawberry Alley, and drives the same day to Trenton Ferry, where Francis Holman meets him, and the passengers and goods being shifted into the waggon of Isaac Fitzrandolph, he takes them to the New York Blazing Star to Jacob Fitzrandolph's the same day, where Rubin Fitzrandolph, with a boat well suited will receive them and take them to New York that night: John Butler, returning to Philadelphia on Tuesday with the passengers and goods delivered to him by Francis Holman, will set out again for Trenton Ferry on Thursday, and Francis Holman, etc., will carry his passengers and goods with the same expedition as above to New York."

Among the most important of the early turnpikes was the one known as the National Road, which was first built from Cumberland to Wheeling and afterwards extended. This was a fine highway and during one period there were four lines of stagecoaches employed on it, the National Line, Pioneer, Good Intent, and June Bug. It was over this road that the first mail-coach carrying the United States mail travelled in August, 1818. The mail-coach left Wheeling at six in the morning and drove the one hundred and thirty-two miles to Cumberland in twenty-four hours. Often as many as fourteen stagecoaches loaded with passengers started off together over this road.

After the Revolution a great many people moved west from New England and in the winter of 1795

twelve hundred sleighs passed through Albany bound for the Genesee Valley. Other prospectors came on horseback, and among these were two young surveyors from Connecticut who noted the bad roads and heavy travel and set about constructing a turnpike. This turnpike first reached from Albany to Schenectady and was later continued to Utica; it was called the Mohawk Turnpike and over it journeyed an immense volume of traffic; there was a tavern at every mile and sometimes a tavern would be stabling a hundred horses at a time.

Although there was so much travelling in the colonies and young republic there was little of that highway robbery that was so common in England. One reason for this is that while Englishmen persisted in carrying gold and banknotes Americans early adopted the habit of using drafts and bills of exchange. Plenty of rascals came out to the colonies, but few took to the career of highwayman, and there were no American "knights of the road" of the same stripe as the English Claude Duval or Dick Turpin.



2

THE NEEDS OF THE NEW REPUBLIC

AS pioneers moved from the rocky fields of New England to the fertile Genesee Valley and as other adventurers crossed the Alleghanies the requirements of better means of communication and transport increased apace. Western New York was found to be a farmer's paradise, where wonderful crops of corn, wheat and other grains could be easily raised. But when the settlers had supplied their own wants the balance of their crops was useless to them; it cost $126 to carry a ton of freight from Buffalo to Albany, and that was very much more than a ton of wheat was worth.

Roads would not solve the problem, and so the people of New York State began to study waterways. From this study emerged the Erie Canal, connecting Lake Erie with the Hudson River. This canal made the fortune of New York and brought within easy reach of the seaboard the country known as the

Middle West. The city on Manhattan Island, which had been exceeded in population, wealth and business by Boston, Philadelphia, Baltimore, now jumped into the lead and became the nation's commercial metropolis, the gateway of the new world. To offset this Baltimore planned a canal connecting Chesapeake Bay and the Ohio River, and Philadelphia a canal from the Susquehanna River to the Ohio, but the territories to be traversed were so mountainous that competition with the Erie Canal and its various branches was found to be impracticable.

Emigrants pressed west, seeking new farms and homesteads; through Cumberland Gap and down the Ohio there was a steady stream of fortune-hunters, carrying with them their household goods and livestock, and floating down the river until they saw fields that attracted them.

The Ohio was the great road, for of all the larger rivers in the eastern part of the country, it is the only one that slopes westward. This stream transported the pioneers that settled Kentucky, much of Indiana, Illinois and Missouri, and sections of the river country in Iowa, Nebraska and Kansas. As land was tilled and trade began Pittsburgh, Cincinnati and Louisville became centres of manufacturing and shipping and the waterways were dotted with the flatboats of the farmers carrying produce to market.

The Louisiana Purchase in 1803 opened the lower Mississippi River to northern commerce and New Orleans became a busy port. When navigation by

steam was demonstrated to be a practical proposition traders in the western country adopted the steamboat. This boomed business on the Ohio and lower Mississippi, and in 1839 the trade of New Orleans equalled that of New York, although the Erie Canal soon allowed New York to underbid its southern rival for transportation of freight from the north to the sea. Meantime also the fur trade was increasing in importance and steamboats on the Missouri River connected St. Louis, the fur headquarters, with the country between the Kansas and Nebraska rivers, from where an overland trail was to carry pioneers across the continent to Oregon and California.

In a country of such vast proportions transportation was all-important and the use of steam as a propulsive power engaged the attention of many minds. As has already been stated, an American, Oliver Evans, invented a steam-carriage in 1772. At about the time when Trevethick was exhibiting his locomotive in England Evans was driving through the streets of Philadelphia in a steam-wagon, built like a boat on wheels, which he called the "Oruktor Amphibolis." In a book published in 1813 he made this prophecy:

"The time will come when people will travel in stages moved by steam-engines from one city to another, almost as fast as birds can fly, fifteen or twenty miles an hour.

"Passing through the air with such velocity,

changing the scenes in such rapid succession, will be the most exhilarating exercise.

"A carriage will set out from Washington in the morning, the passengers will breakfast in Baltimore, dine at Philadelphia, and sup at New York the same day.

"To accomplish this, two sets of railways will be laid (so nearly level as not to deviate more than two degrees from a horizontal line), made of wood or iron, on smooth paths of broken stone or gravel, with a rail to guide the carriages, so that they may pass each other in different directions, and travel by night as well as by day; and the passengers will sleep in these stages as comfortably as they now do in steam stage boats.

"Twenty miles per hour is about thirty-two feet per second, and the resistance of the air will then be about one pound to the square foot; but the body of the carriages will be shaped like a swift-swimming fish, to pass easily through the air. . . .

"The United States will be the first nation to make this discovery, and to adopt the system, and her wealth and power will rise to an unparalleled height."

This vision of steam railways was shared by Colonel John Stevens, of Hoboken, who wrote this letter to the New York Commissioners for the Improvement of Internal Navigation in 1812:

"Let a railway of timber be formed, by the nearest practicable route between Lake Erie and Albany, the

The De Witt Clinton, the First Locomotive Run in the State of New York, 1831

The Best Friend, the First Locomotive Built in the United States for Actual Service, 1831

From History of the First Locomotives in America W. H. Brown

angle of elevation in no part to exceed one degree, or such an elevation, whatever it may be, as will admit of wheel carriages, to remain stationary, whenever no power is exerted to propel them forward. This railway throughout its course to be supported on pillars raised from three to five or six feet above the surface of the ground. The carriage wheels of cast iron, the rims flat, with projecting flanges, to fit on the surface of the railways. The moving power to be a steam-engine nearly similar in construction to the one on board the 'Juliana,' a ferryboat plying between this city and Hoboken."

The commissioners, however, thought that Colonel Stevens' project would be too expensive, and also objected, as so many were objecting in England, that the locomotive would not have grip or bite enough to draw a heavy load along the rails. Stevens said that his railroad could be tested at a cost of about three thousand dollars, but his offer was not taken up.

The first actual railway in the United States was the "Granite Railroad," sometimes called the "Experiment Railroad," constructed by Gridley Bryant in 1826. This was used to carry heavy blocks of granite for the building of the Bunker Hill Monument from the quarries at Quincy, Massachusetts, to the docks four miles away. Bryant had studied the railways of George Stephenson and had made some inventions of his own, such as the switch, the portable-derrick, and the eight-wheeled car, all of which he

used on the Quincy road. This railway, the vehicles drawn by horses, excited the greatest curiosity and admiration throughout the country.

The Quincy road had a considerable incline from the quarries to the landing-place on the Neponset River, and a single horse could draw immense loads over the rails. From the wharf the granite blocks were towed around the harbor by a steam tow-boat to their destination at Charlestown. The cost of the railroad was about thirty-four thousand dollars. There was a double track made of stone ties placed eight feet apart and upon these were laid longitudinal beams plated on the top with iron. The cars carried their load on a platform slung under the axle or, if the blocks were very large, they were held in place by chains. The wheels were made of wood, six feet in diameter, and were shod with iron, with a flange on the inner side of the rim. To clear the roadway of snow a snow-plough was invented, which is described thus by a contemporary writer: "Even the late snow, which is deeper than has before fallen for several years, has presented no obstruction. On first passing, while the snow was light, two pieces of plank were placed before the car, meeting in an angle at the centre, and drawn along the rails, and by this means the snow was effectually removed, so as to render the travelling of the wheels as free as in summer."

The next railway built was the "Gravity" road, of Mauch Chunk, Pennsylvania, which was completed

in May, 1827. This was nine miles in length and was used to carry coal from the Summit mines in Carbon County, Pennsylvania, to a landing on the Lehigh River. The railway was constructed with a series of inclines and the cars were moved by gravity and mule-power. The mules were allowed to ride down the inclines on sliding platforms, and it is said that they enjoyed this sport so much that they always refused to walk down the slopes.

Canals were still regarded as the best method of transporting freight and passengers any considerable distance, but, although they could be carried over hills by means of locks and inclined planes, they could not be constructed across mountain ranges. For this some other method must be adopted, and therefore, when reports came of George Stephenson's success with his new steam-wagons, the officials of the Delaware and Hudson Canal Company sent their assistant engineer, Horatio Allen, to England to attend the prize competition of locomotives at Rainhill and to purchase three of Stephenson's engines.

3

THE *STOURBRIDGE LION* AND *TOM THUMB*

IT was a locomotive built on George Stephenson's plan that inaugurated the new era in American transportation. Horatio Allen went to England and, having studied the "Rocket" and others of Stephenson's engines, tried to get the inventor to construct three locomotives for him. Stephenson was too busy to fill this order, but four locomotives were built according to his specifications by Foster Raswick and Company, of Stourbridge. The first of these arrived in New York in May, 1829. It was of what was called the "grasshopper" make from its mass of exterior valves and joints; and because it had a picture of a lion's head painted in bright red on the front of the boiler it was dubbed the "Stourbridge Lion."

Landed in New York, the locomotive was placed on exhibition and all the townspeople flocked to view the strange creature. Then it was packed on board a steamboat and conveyed to Rondoubt, and thence shipped by canal to Honesdale, Pennsylvania. There

Allen placed the "Lion" on the railway which had been constructed over a mountain to Carbondale, seventeen miles from Honesdale. To witness the trial trip on the ninth of August many farmers had assembled from miles around, and to add to the demonstration an old Queen Anne cannon had been brought from New York.

The track for the locomotive was built of hemlock stringers on which bars of iron had been spiked, and as it had been laid in summer the unseasoned rails had become considerably warped and twisted. The railway crossed the Lackawaxen Creek on a hemlock trestle, one hundred feet high, and as the locomotive weighed seven tons instead of three tons, as the stipulations called for, many people urged the engineer not to try to cross the bridge.

Allen would not be deterred, however. His answer was to invite some of the spectators to ride with him; but none of the crowd accepted the invitation. Then he ran the engine up and down the coal dock several times, pulled the throttle-valve open, shouted a good-bye to the throng, and dashed away around a curve and over the trestle at a rate of ten miles an hour. After running some miles he returned safely to the welcoming cheers of the crowd, the waving of flags and the booming of cannon.

The "Stourbridge Lion" proved itself as a successful locomotive, but the wooden rails were unsatisfactory for the use of the engine and as the canal company could not afford to buy iron rails the loco-

motive was housed in a shed and later dismantled.

The scene next shifts to Baltimore. The people there were deciding in 1826 that they must do something to regain the trade they had lost through the Erie Canal and the roads of Pennsylvania and came to the determination to build some kind of a railroad through the Potomac Valley and over the Alleghanies to the Ohio River. The first section of this road, consisting of a double track extending thirteen miles to Ellicott's Mills, was opened in 1830. The question then was: What motive-power should be used on the road? Various schemes were tried. Evan Thomas constructed a car with sails, which would run when the wind was in the right quarter. A horse-power car was tried, but on one occasion, when a party of inspection was aboard, the car ran into a cow and the passengers were pitched out into a ditch. Peter Parley, writing of this period in Maryland, says: "The people are building what is called a railroad. This consists of iron bars laid down along the ground and made fast, so that carriages with small wheels may run upon them with facility. In this way one horse will be able to draw as much as ten horses on a common road. A part of the railroad is already done, and if you choose to take a ride upon it you can do so. You enter a car something like a stage, and then you will be drawn along by two horses at a speed of twelve miles an hour."

At this point Peter Cooper, the famous merchant and philanthropist, comes into the story. He after-

wards gave in the *Boston Herald* for July 9, 1882, this graphic and picturesque account of his first railroad venture:

"It is now about fifty-five years since I was drawn into a speculation in Baltimore. Two men there, whom I knew slightly, came up and asked me to join them in buying a tract of three thousand acres of land within the city limits. It included the shore for three miles, and the new Baltimore and Ohio railroad was going to run through it. The road was chartered, and a little of it was graded. Its cars were to be drawn by horses; nobody thought of the possibility of steam. I consulted my friend Gideon Lee, . . . and he advised me that it was a good scheme. He said the land was worth five hundred thousand dollars, whether the road was ever finished or not. So I went to Baltimore, saw the land, and agreed to take one-third, and paid my money, twenty thousand dollars.

"They drew on me every little while for taxes, etc., and when, at the end of a year, I went down again, I found out that neither of my partners had paid a cent on the purchase, and that I had been sending down money to pay their board! The Baltimore and Ohio railroad had got some wooden rails laid, and thinking it might amount to something, I bought my swindling partners out, paying one of them ten thousand dollars. I thought it would pay, for the Baltimore and Ohio railroad had run its tracks down to Ellicott's Mills, thirteen miles, and had laid 'quakehead' rails, as they called them, strap

rails, you know, and had put on horses. Then they began to talk about the English experiments with locomotives. But there was a short turn of one hundred and fifty feet radius around Point of Rocks, and the news came from England that Stephenson said that no locomotive could draw a train on any curve shorter than a nine hundred foot radius. The horse-car didn't pay and the road stopped. The directors had a bad fit of the blues. I had naturally a knack at contriving, and I told the directors that I believed I could knock together a locomotive that would get the train around Point of Rocks. I found that my speculation was a loss unless I could make the road a 'go.'

"So I came back to New York and got a little bit of an engine, about one horse-power (it had a three and a half inch cylinder, and fourteen inch stroke), and carried it back to Baltimore. I got some boiler iron and made a boiler, about as big as an ordinary washboiler, and then how to connect the boiler with the engine I didn't know. . . .

"I had not only learned coach-making and wood carving, but I had an iron-foundry and had some manual skill in working in it. But I couldn't find any iron pipes. The fact is that there were none for sale in this country. So I took two muskets and broke off the wood part, and used the barrels for tubing to the boiler, laying one on one side and the other on the other. I went into a coach-maker's shop and made this locomotive, which I called the 'Tom Thumb,' because it was so insignificant. I didn't intend it for

actual service, but only to show the directors what could be done. I meant to show two things: first, that short turns could be made; and, secondly, that I could get rotary motion without the use of a crank. I effected both of these things very nicely. I changed the movement from a reciprocating to a rotary motion. I got steam up one Saturday night; the president of the road and two or three gentlemen were standing by, and we got on the truck and went out two or three miles. All were very much delighted, for it opened new possibilities for the road. I put the locomotive up for the night in a shed. All were invited to a ride Monday—a ride to Ellicott's Mills. Monday morning, what was my grief and chagrin to find that some scamp had been there, and chopped off all the copper from the engine and carried it away —doubtless to sell to some junk dealer. The copper pipes that conveyed the steam to the piston were gone. It took me a week or more to repair it. Then (on Monday it was) we started—six on the engine and thirty-six on the car. It was a great occasion, but it didn't seem so important then as it does now. We went up an average grade of eighteen feet to the mile, and made the passage (thirteen miles) to Ellicott's Mills in an hour and twelve minutes. We came back in fifty-seven minutes. Ross Winans, the president of the road, and the editor of the *Baltimore Gazette,* made an estimate of the passengers carried and the coal and water used, and reported that we did better than any English road did for

four years after that. The result of that experiment was that the bonds of the road were sold at once, and the road was a success."

The "Tom Thumb" behaved gallantly. Peter Cooper had built the first American locomotive and had demonstrated that it could run at a speed of fifteen miles an hour round curves of a short radius and ascend grades with comparative ease. The locomotive weighed about a ton, the wheels were two and a half feet in diameter, and the smoke-stack was described as looking "like an aggravated putty-blower." The fuel used was anthracite coal. The tubes in the upper part of the boiler were arranged on a similar pattern to the multitubular system that was being worked out at the same time in England by George Stephenson. In addition to this multitubular invention Peter Cooper had also invented a steam-blast apparatus, independently of Stephenson's, which consisted of a sort of bellows, which was worked by a belt that ran over a drum and was geared with the car-wheels.

Soon after the "Tom Thumb" had made its successful trial run the stagecoach proprietors, Stockton and Stokes, of Baltimore,—thinking that the new locomotive menaced their business, since people might prefer to travel in steam-drawn carriages rather than in horse-drawn coaches,—resolved to show what horses could do in competition with the locomotive. When they heard that the engine was on the track with a load of passengers they attached

one of their best horses to a car filled with riders placed on the second track and met the "Tom Thumb" on its return journey at a point called the Relay House. The horse-train challenged the steam-train to a race, and Peter Cooper, who was driving his locomotive, accepted the challenge. Amid shouts and cries of defiance from the two sets of passengers the race began. The horse set the pace, springing away at the word "go," and won a lead of a quarter of a mile while the "Tom Thumb" was getting up steam. Then the locomotive began to gain, caught up with its rival, and the two raced neck-and-neck. The driver plied his whip and the horse, a splendid steed, pulled his load for some distance nose-to-nose with the locomotive. Steam forged ahead, however, and the "Tom Thumb's" passengers gave a great cheer as their rivals fell behind. The driver was about to give up the race when, of a sudden, something happened to the locomotive. The leather band that turned the pulley that moved the blower slipped from the drum and the engine lost momentum. Cooper tried to replace the band on the wheel, but only succeeded in injuring his hands. The horse went ahead and gained such a lead that, although Cooper was finally able to repair his engine, the horse-train came in the winner over the "Tom Thumb."

This accident somewhat discouraged the promoters of the steam-railway and until 1831 horses were used on this road.

The first regular passenger railway in America to

employ steam-locomotives was the Charleston and Hamburg, of South Carolina, which was chartered in 1827. On this line the first locomotive built for actual service—an engine called the "Best Friend"—was running in December, 1830.

Steam-roads were winning their way, and now at Albany, New York, the Mohawk and Hudson Company was to make a notable demonstration of the success of the new method of transportation in the trial trip of their engine, the "De Witt Clinton."

4

THE *DE WITT CLINTON* AND *OLD IRONSIDES*

THE Mohawk and Hudson Railroad had been running cars drawn by horses for some time on its line between Albany and Schenectady when in 1831 it ordered a locomotive built at the West Point Foundry. This engine, christened the "De Witt Clinton," was the third constructed for actual railway use in the United States and the first to draw a passenger train in the northern section of the country. It was delivered at Albany by river-boat from the foundry and the directors of the company planned a grand celebration to mark the opening of the steam line on August 9, 1831.

Crowds of spectators flocked to Lydius Street in Albany early that morning. On the track stood the "De Witt Clinton" in front of a tender containing water, fuel, three passenger cars, made of the bodies of stagecoaches fastened on railroad trucks, and several flat cars. All along the seventeen miles of the road to Schenectady farmers and their families had gathered to see this new, strange, iron steed put

through its paces. If the locomotive was successful it would mean much to the dwellers along the Hudson.

Tickets for the ride had been sold at hotels and other public places, and the ticket-holders climbed into the carriages and took their seats. The conductor, standing on a platform outside each coach, collected the tickets, then mounted to a little seat on the tender and blew a horn. The engine gave a great jerk and the crowd burst into cheers. It was not a smooth start; quite the contrary in fact; the tender was fastened to the locomotive by a chain made of three large links, the chain was two to three feet slack, the first passenger carriage was attached in a similar manner to the tender and the second coach to the first and also the flat cars following the carriages; therefore when the engine started it took up the slack by jerks and bounced the unwary passengers out of their seats. The locomotive jumped forward so quickly that the engineer only kept from being flung backward by seizing a support and hanging on to it.

The passengers in the cars, sprawling across each other on the floor, untangled themselves, found that no bones were broken, and resumed their places. The engine, now pulling steadily, straightened out the train and drew it along smoothly. Soon, however, another misadventure befell. The locomotive used dry pitch-pine for fuel, and as there was no smoke or spark catcher in the chimney, or smokestack, a great

cloud of black smoke, filled with cinders and burning sparks, rolled over the whole train. The passengers in the covered coaches had some protection and those on the flat cars at the rear who were provided with umbrellas raised them, but the flying sparks lighting on the umbrellas speedily burnt the covers from the frames. Then the travellers' clothing caught fire and soon the riders were beating each other with their hands, trying to extinguish the flames. For the first few miles the train presented the appearance of an amateur fire brigade hard at work.

The "De Witt Clinton" steamed along until it reached a point on the track where its supply of water was to be renewed. There, opposite the tank, the engineer pushed a lever that was designed to apply brakes to the wheels and slow the train. The contrivance worked admirably; the engine was abruptly checked, the tender bumped into the locomotive, the first passenger carriage crashed against the tender, the second coach rammed the first, and each of the flat cars catapulted into the one in front of it. The passengers, still fighting sparks, were again sent sprawling, now backward from their seats instead of forward as they had been jerked when the train started.

As soon as the train halted and the passengers could pick themselves up they climbed down from the cars and put out the fires that smouldered in some of their garments. Then they tore down a farmer's fence, and chopped the rails into lengths that would

fit into the spaces between the various cars. The links that coupled the engine, tender, coaches and flat cars together were stretched to full tension, the fence-rails were extended horizontally between each pair of cars and fastened in place by packing-yarn used for the cylinders. In this way the train was given rigidity; satisfied that they would now be neither bumped nor jerked, the passengers got aboard again, the engineer took on his fresh supply of water, and the "De Witt Clinton" drew its load without further mishap to the welcoming throngs at Schenectady.

One of the passengers on the train says this of the journey: "Everybody, together with his wife and all his children, came in all kinds of conveyances, and, being as ignorant of what was coming as were their horses, drove up to the railroad as near as they could get, only looking for the best position to secure a view of the train. As it approached, the horses took fright and wheeled, upsetting buggies, carriages, and wagons, and leaving for parts unknown to the passengers, if not to their owners, and it is not now positively known if some of them have yet stopped."

The train made the return journey from Schenectady to Albany in thirty-eight minutes.

A clever silhouette-artist, William H. Brown, happened to be in Albany on that day and made a rough drawing of the locomotive, tender and first two passenger-coaches, and later, using that sketch as a model, he cut out of a sheet of black paper his profile picture of the train, which gave an accurate and

THE *DeWitt Clinton* DREW ITS LOAD TO THE WELCOMING THRONGS AT SCHENECTADY

extremely interesting representation of this famous engine and its carriages ready for the first trip. The Mohawk and Hudson Railroad—which afterwards became part of the New York Central system—utilized the "De Witt Clinton" for fourteen years on its regular passenger service, and the little engine faithfully did its work. In the season of 1832–33, when there were very heavy falls of snow all along the line, on only one day did the locomotive fail to complete its run.

The example of the Mohawk and Hudson Railroad in establishing steam trains for passenger service was imitated in other parts of the east. The first passenger train in Pennsylvania made its trial trip in November, 1832. It was drawn by "Old Ironsides," a locomotive built by M. W. Baldwin, who founded the celebrated Baldwin Locomotive Works in Philadelphia. This was the only engine used on the Philadelphia, Germantown and Norristown Railway at that time and whenever repairs were needed they were made at night. The locomotive had wooden spokes and wrought iron tires, and sometimes the eccentrics stuck so that the train could move in neither direction. "Old Ironsides" weighed seven tons, and was considered so heavy by the directors that they almost rejected it but were persuaded by Baldwin to give it a trial. On its first run the wheels were found to be too light to keep the engine on the track, so the builder and two machinists pushed it until it had gained considerable speed and then all three

jumped aboard to keep the wheels down by their joint weight. The boiler also proved too small for the engine and only generated steam sufficiently fast to keep it in motion a short distance, so that the engineer and his assistants had alternately to push and ride to make the journey from Philadelphia to Germantown. On the return trip the pipe that connected the tank and the boiler became frozen and had to be thawed out with a fire made of rails.

Experiments, however, rapidly taught American locomotive builders how to overcome the initial defects and the third decade of the century saw the little engines with their high smoke stacks drawing car-loads of passengers in all the more thickly populated districts along the Atlantic coast.

5

PIONEER RAILROAD TRAVEL IN THE EAST

MASSACHUSETTS was somewhat slower than some of the other states to build steam railroads, but when she had once begun proceeded ambitiously. The Boston and Lowell, the Boston and Providence, and the Boston and Worcester railroads were all opened for service in 1835. On the Worcester road the passenger cars were shaped like coaches and ran on single trucks; the cars for freight were constructed like wagons and had canvas covers similar to those used on the Conestoga wagons. Previous to the opening of the railway baggage-wagons had made the journey from Worcester to Boston in a week if the weather was fine; the trip by locomotive was accomplished in three hours. Advertisements announced that steam trains would run on this line "three times each day during the warm season, and twice a day during the cold season, excepting Sundays."

In New England the same objections were made to

the new idea as had been launched in old England. Great damage would be done to the farmers, horses would no longer be needed and there would be no market for oats and hay, domestic animals would be injured by the noise of locomotives, property would be destroyed by the sparks from the engines. Each successive plan for a new road roused more criticism, opposition and abuse. The *Boston Courier* of June 27, 1827, declared: "The project of a railroad from Boston to Albany is impracticable, as every one knows who knows the simplest rule of arithmetic, and the expense would be little less than the market value of the whole territory of Massachusetts; and which, if practicable, every person of common sense knows would be as useless as a railroad from Boston to the moon."

As late as 1842 the people of Dorchester resolved in a town meeting: "That our representatives be instructed to use their utmost endeavors to prevent, if possible, so great a calamity to our town as must be the location of any railroad through it, and if that cannot be prevented, to diminish this calamity as far as possible" by building the road through the marshes and over creeks.

A railroad was built, however, from Boston to Albany through the Berkshire hills and completed in December, 1841. Officials from Boston and neighboring eastern towns made a triumphal journey over the new line, and some of the party from New Bedford, to celebrate the astonishing fact of their arrival in

Albany fifteen hours after starting out, had some spermaceti candles specially moulded, took the candles on the trip, and lighted them at the civic banquet held in Albany in honor of the event. Next day the authorities of Albany made the return journey to Boston with their eastern guests and not to be outdone by the New Bedford candles the New Yorkers carried with them a barrel of flour, the wheat for which had been threshed at Rochester two days before. This flour, made into bread, graced the board at the dinner given in Boston to the officials of the two cities and other guests.

These pioneer railroads expedited travel, but journeys by train had many drawbacks. Accidents were frequent, sometimes passengers were injured, sometimes only discommoded. The locomotive would get into trouble and the train would have to be pulled to the next station by horses or oxen and a long wait made until the engine could be repaired. On some lines the roadbed of the track was made of a stone wall surmounted by a rail of split granite about a foot in thickness and depth, with a bar of iron on top for the carriage wheels. Such a rock-bedded road caused constant jarring of the train, which tired the passengers. The cars usually had no springs, and the train was stopped by a hand or foot brake, which jolted the carriages almost as severely as though they had met with a collision. Occasionally the brake-power was even more primitive; on the Newcastle and Frenchtown Railroad it was the custom for the

engineer to open his safety valve on reaching a station and then several negroes would seize the last car and attempt to hold it while the station agent would put sticks of wood through the spokes of the wheels and so arrest the momentum.

The Philadelphia and Reading Railroad used in 1836 what was called a Monitor or raised roof car. This was longer and lower than the customary passenger cars patterned on the stagecoach and the seats were placed around the sides as in an omnibus. The car was entered from the side and at each end was a small room, one for toilet purposes and the other furnished with a bar, where passengers could obtain refreshments to while away the tedium of the journey.

Freight cars on the pioneer roads were often called "burthen" cars; trains were referred to as "brigades" of cars. The freight cars were built like boxes, a little longer than they were wide, with a wheel at each corner. Some of the locomotives had very large driving-wheels, twelve feet in diameter. One railroad solved the problem of a head-light by placing a quantity of pitch-pine on a platform car, the floor being thickly covered with sand. The platform car preceded the engine and the blazing pine-knots brightly illuminated the track. Most of the early railroads used wooden rails upon which strap iron was spiked. Frequently these strap rails, owing to the weight of the trains on their central sections and the action of heat and frost, would curl up, and then, when the ends of the rails were struck by a car-wheel,

they would sometimes be driven up through the bottom of the car and the engineer would have to stop the train and pound down the "snake-head," as the curled end was called, or have an assistant hold the rail down with a lever while the train passed over it.

In England the term "coach," reminiscent of stagecoach days, clung to railway carriages; in America, however, probably due to the circumstance that the coach-like vehicle was early discarded on the roads, the railway carriage was frequently called a "car." In coaching days travellers "booked" seats for a ride, and in England ticket-agents still employ the phrase of "booking" passengers for the railway coaches. This expression was also originally used on the American roads, where it was often the custom to write the names of the passengers in a book at the railroad station; but the custom was gradually given up as the volume of travel increased.

The passengers were a motley crowd. Most of them considered the new railroads a great improvement on the stagecoaches, but there were some who still hankered after the more leisurely method of travelling. Samuel Breck, of Boston, made this entry in his journal:

"July 22, 1835.—This morning at nine oclock I took passage in a railroad car (from Boston) for Providence. Five or six other cars were attached to the locomotive, and uglier boxes I do not wish to travel in. They were made to stow away some thirty human beings, who sit cheek by jowl as best they can.

Two poor fellows, who were not much in the habit of making their toilet, squeezed me into a corner, while the hot sun drew from their garments a villainous compound of smells, made up of salt-fish, tar, and molasses. By-and-by, just twelve—only twelve—bouncing factory girls were introduced, who were going on a party of pleasure to Newport. 'Make room for the ladies!' bawled out the superintendent. 'Come, gentlemen, jump up on the top; plenty of room there.' 'I'm afraid of the bridge knocking my brains out,' said a passenger. Some made one excuse, and some another. For my part, I flatly told him that since I had belonged to the corps of Silver Grays I had lost my gallantry, and did not intend to move. The whole twelve were, however, introduced, and soon made themselves at home, sucking lemons, and eating green apples. . . . The rich and the poor, the educated and the ignorant, the polite and the vulgar, all herd together in this modern improvement in travelling. . . . And all this for the sake of doing very uncomfortably in two days what would be done delightfully in eight or ten."

Charles Dickens made a visit to the United States in 1842, and described his adventures in his "American Notes." One adventure was an excursion from Boston to Lowell. This is the picture he gives of his railway experience:

"I made acquaintance with an American railroad, on this occasion, for the first time. As these works are pretty much alike all through the States,

their general characteristics are easily described.

"There are no first and second class carriages as with us; but there is a gentleman's car and a ladies' car: the main distinction between which is that in the first, everybody smokes; and in the second, nobody does. As a black man never travels with a white one, there is also a negro car; which is a great blundering clumsy chest, such as Gulliver put to sea in, from the kingdom of Brobdingnag. There is a great deal of jolting, a great deal of noise, a great deal of wall, not much window, a locomotive engine, a shriek, and a bell.

"The cars are like shabby omnibuses, but larger: holding thirty, forty, fifty, people. The seats, instead of stretching from end to end, are placed crosswise. Each seat holds two persons. There is a long row of them on each side of the caravan, a narrow passage up the middle, and a door at both ends. In the centre of the carriage there is usually a stove, fed with charcoal or anthracite coal; which is for the most part red-hot. It is insufferably close; and you see the hot air fluttering between yourself and any other object you may happen to look at, like the ghost of smoke.

"In the ladies' car, there are a great many gentlemen who have ladies with them. There are also a great many ladies who have nobody with them: for any lady may travel alone, from one end of the United States to the other, and be certain of the most courteous and considerate treatment everywhere. The conductor or check-taker, or guard, or whatever

he may be, wears no uniform. He walks up and down the car, and in and out of it, as his fancy dictates; leans against the door with his hands in his pockets and stares at you, if you chance to be a stranger; or enters into conversation with the passengers about him. A great many newspapers are pulled out, and a few of them are read. Everybody talks to you, or to anybody else who hits his fancy. . . .

"Except when a branch road joins the main one, there is seldom more than one track of rails; so that the road is very narrow, and the view, where there is a deep cutting, by no means extensive. When there is not, the character of the scenery is always the same. Mile after mile of stunted trees: some hewn down by the axe, some blown down by the wind, some half fallen and resting on their neighbors, many mere logs half hidden in the swamp, others mouldered away to spongy chips. . . . Now you emerge for a few brief minutes on an open country, glittering with some bright lake or pool, broad as many an English river, but so small here that it scarcely has a name; now catch hasty glimpses of a distant town, with its clean white houses and their cool piazzas, its prim New England church and school-house; when whir-r-r-r! almost before you have seen them, comes the same dark screen: the stunted trees, the stumps, the logs, the stagnant water—all so like the last that you seem to have been transported back again by magic.

"The train calls at stations in the woods, where the

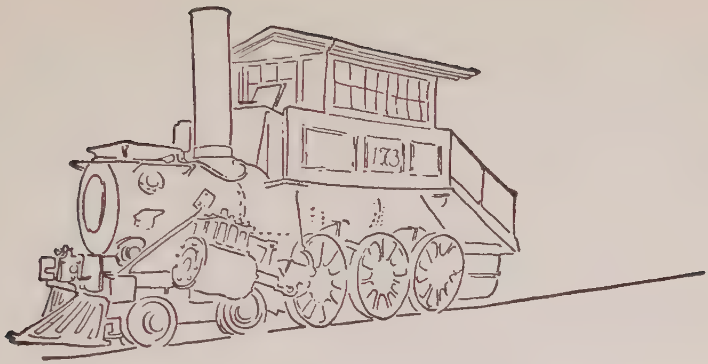
wild impossibility of anybody having the smallest reason to get out, is only to be equalled by the apparently desperate hopelessness of there being anybody to get in. It rushes across the turnpike road, where there is no gate, no policeman, no signal: nothing but a rough wooden arch, on which is painted 'When the bell rings, look out for the Locomotive.' On it whirls headlong, dives through the woods again, emerges in the light, clatters over frail arches, rumbles upon the heavy ground, shoots beneath a wooden bridge which intercepts the light for a second like a wink, suddenly awakens all the slumbering echoes in the main street of a large town, and dashes on haphazard, pell-mell, neck or nothing, down the middle of the road. There—with mechanics working at their trades, and people leaning from their doors and windows, and boys flying kites and playing marbles, and men smoking, and women talking, and children crawling, and pigs burrowing, and unaccustomed horses plunging and rearing, close to the very rails—there—on, on, on—tears the mad dragon of an engine with its train of cars; scattering in all directions a shower of burning sparks from its wood fire; screeching, hissing, yelling, panting; until at last the thirsty monster stops beneath a covered way to drink, the people cluster round, and you have time to breathe again."

Other Trans-Atlantic travellers were more favorably impressed by the railroads of the United States. An Englishman, Joseph Biggs, who crossed the ocean

in 1837, wrote in his diary: "There is no country where you can travel with such facility and cheapness as in America. There are already railways throughout all the New England States to every town of importance, and some thousand miles in progress in the South and West. In a few years you will be able to pass from the Gulf of Newfoundland to the Gulf of Mexico, from icebergs to orange groves in five days.

"Whilst the English have almost stood still contemplating with great complacency the two or three splendid railways which they have made, the Americans have laid down many hundreds of miles. There is certainly no unnecessary expense incurred in their construction. The line appears in places like a huge frame of timber laid on the ground, on which the rails are screwed; the sleepers are not filled up with earth, and often in passing a marsh or a lagoon the single line is barely wide enough for the train.

"The engineers seem to have the 'power' under better control than we have; I have seen a train moving at the rate of seventeen miles an hour stopped in forty yards. The engine carries a sort of large shovel in front, which removes obstacles on the rails. Riding on the engine of a Washington train at night I saw a cow lying on the rails. We were upon her at once, and I expected a terrible concussion, instead of which the shovel scooped her up and carried her a few yards, when she fell off on the roadside and the train passed on scathless."



6

ACROSS THE ALLEGHANIES

AS in England, so in Pennsylvania it was the needs of the coal mines that led to the first use of railways. The Delaware and Hudson Canal Company—which brought the "Stourbridge Lion" to the United States in 1829—had built a gravity railroad in 1828 for the purpose of carrying coal to convenient shipping points. This was the enterprise of the Philadelphia Quakers, William and Maurice Wurts, who wanted to connect their coal mines in the valley of the Lackawanna with tidewater on the Hudson River by means of a canal. The railroad filled up a gap seventeen miles long and was constructed of eight inclined planes from one to four miles in length.

The first railroad built across the Alleghany Mountains was the Portage Road, which also utilized inclined planes. This formed a link in the system of canals and horse-railways built by the state of Penn-

sylvania to connect Philadelphia and Pittsburgh. The whole distance of three hundred and ninety-three miles between the two cities was covered in four sections. From Philadelphia to Columbia, eighty-two miles, there was a horse-railway, completed in 1833. At Columbia passengers and freight were transferred to the boats of the Pennsylvania Canal, which reached one hundred and seventy-two miles to Hollidaysburg, at the eastern foot of the Alleghanies. The canal boats were built in sections, and at Hollidaysburg they were taken apart, loaded on wheeled trucks, and carried to Johnstown on the other side of the mountains by the Portage Road. From Johnstown to Pittsburgh the journey was made by the western division of the Pennsylvania Canal. The Portage Road was thirty-six miles in length, and crossed the mountains at Blair's Gap, the summit of which was 2326 feet above the sea. The railroad passed over eleven levels, ten inclined planes, four viaducts, and through a tunnel. The trains of four cars each were drawn up and let down by stationary engines, one train ascending as the other descended. The rails were chained to cross blocks of sandstone. The Portage was a remarkable achievement and was in constant use until the Pennsylvania Railroad in 1854 built its tracks over the Alleghanies.

When the "De Witt Clinton" made its famous run from Albany to Schenectady on August 9, 1831, there was no railroad west of the Alleghanies and south

of the Ohio River, but in that year the citizens of Lexington, Kentucky, began to plan a railway of their own from Lexington to Frankfort, the nearest important town on the Kentucky River. Henry Clay was one of the influential stockholders of the new line. The roadbed, as it was first built, was made of longitudinal limestone sills with cross-ties laid beneath them every four or five feet. The rails were strips of iron, fastened to the sills by means of lead or sulphur. The frosts of the first winter broke the stone sills and they were replaced by wood. The road was laid on a very crooked pattern, advocated by the engineers, who said that the conductor would be able to look back along the curves and see the passengers in the rear cars. The cars that were first used were two story vehicles, something like stagecoaches; the lower story was for women and children, the upper for men, although in summer weather before the locomotive replaced the horses or mules that originally pulled the cars many women preferred to sit on the top deck. The first locomotive was a very primitive affair made by a Lexington mechanic; it had no cab, and the tender was an open box-car that held a small supply of wood and a hogshead of water which was filled by pumping from a well at the side of the road. In place of a pilot or "cow-catcher" two large beams stuck out in front and hickory brooms were attached to them for sweeping the track. When the locomotive was first put on the railway the directors invited guests to make a trip to Frankfort in a "brigade"

of little platform cars. When the train drew near Frankfort snow began to fall and the engineer stopped his locomotive under a shed and refused to drive it further, stating that the wet track would be likely to derail the train. As the snow continued to fall the celebrating party had to get down from the cars and return home on foot.

At Frankfort, which is situated in a valley, the trains of the Lexington Railroad were lowered down an incline by a stationary engine, and on one occasion the cable broke and a train dashed down at tremendous speed, knocking out the end of the depot and smashing up the cars as well as injuring some of the passengers.

The first railroad in Ohio was the Mad River and Lake Erie, which ran from Springfield to Sandusky. Work on this was begun in September, 1835. The first engine used on the road was the "Sandusky," which is said to have been the first locomotive to have a regular steam-whistle; the "Sandusky" was built at Paterson, New Jersey, by an American, William Swinburne, who volunteered to construct a steam-engine when an English mechanical draughtsman who had been engaged by the company was unable to complete a satisfactory locomotive.

On the western prairies the pioneer road was the Northern Cross, later known as the Great Wabash. Originally this line extended from Meredosia, on the Illinois River, to Springfield, Illinois. The legislature of Illinois appropriated in 1837 the sum of ten

million dollars for state improvements, and a large part of this was to be spent on railroads. Work on several roads began, but then came a financial crash, and construction on all the lines was suspended except on that of the Northern Cross, which was almost completed, and which was quickly finished to Springfield. The first locomotive was placed on the track on November 8, 1838. The cab of this engine was open to the sky; it had no whistle, no spark-arrester, no "cow-catcher"; its speed was about six miles an hour, and six inches of snow were enough to block its passage. The historian of this road, A. A. Graham, tells of a meeting between the engineer Daniels and an angry bull who took up his station on the track before the train and refused to budge. Says the account: "Daniels came up to him, but unflinchingly and defiantly he held his place. Daniels shouted, threw sticks of wood at him and swore, but all to no purpose; the bull had the track and meant to keep it. Daniels backed his train and came up again, making all the noise he could, but this only incensed the bull, and immovably he kept his place. The third time the engineer tried to scare him off by touching him with the engine, but there he stood, master of the situation. By this time Daniels got mad and said: 'By Dads, I'll try which has the hardest head!'

"The meeting came near being disastrous to both, but Taurus went tumbling down the bank, never to repeat his experiment."

The Northern Cross was not a profitable venture

at the outset, and its first locomotive had a checkered career. The engineer ran it off the track, burnt out the flues, and it was left abandoned on the prairie. Afterwards it was purchased by General Semples, of Alton, who had the notion of using road locomotives on the plains; he put on a new set of wheels, with tires two feet wide, changed the construction of the engine, and made a trial trip from Alton to Springfield. He found it necessary to take along a yoke of oxen to pull the locomotive out of mud-holes, and that one trip was sufficient to prove to him that he could not make his new-fangled road engine pay.

Here and there in the east and the middle west there were now short lines of railroads serving business centres. The next step was the organization of these scattered roads into larger systems, which, by means of branches connecting with main trunk lines, should knit up farming communities with the growing cities and thus unite the country in a compact, commercial whole. The Baltimore and Ohio Railroad was a pioneer in this new development, reaching, with many branches, from Chesapeake Bay westward. In New York City Commodore Vanderbilt, a promoter of canals and steamboats, formed a company to buy up various small eastern lines and consolidated them in the New York Central. The Pennsylvania Central—now the Pennsylvania Railroad—was built out of many lines to furnish transport from the Atlantic over the mountains and as far

THE WEST POINT, THE SECOND LOCOMOTIVE BUILT IN THE UNITED STATES FOR ACTUAL SERVICE, 1831

RACE BETWEEN A HORSE-CAR AND THE TOM THUMB, 1830

From History of the First Locomotives in America—W. H. Brown

as the Mississippi. The Erie Railroad had a network over four hundred miles long. The Rock Island Railroad pushed out from Chicago, crossed the Mississippi in 1859 and extended west on the plains.

Westward the Star of Empire takes its course! Intrepid adventurers and pioneer families in their Conestoga wagons had toiled across the great plains and the snow-capped Rocky Mountains to the fertile Pacific valleys; now in their footsteps came the railroad builders, men of far vision and indomitable courage, to link the two oceans with their steam-driven steeds.

7

THE LINKING OF THE CONTINENT

§ I

THE TRAIL OVER PLAINS AND MOUNTAINS

THE United States had step by step stretched from the original thirteen colonies along the Atlantic seaboard to San Francisco Bay. The Louisiana Purchase had added much, a great tract was acquired when the republic's claim to the Oregon Territory was granted, Texas had become part of the Union; the nation reached from ocean to ocean and from the Rio Grande on the south to the generally accepted 49° on the north. Gold in California brought crowds of adventurers and after them more useful settlers, the Mormons had trekked from Illinois to Utah and were planting those far western fields, here and there were scattered hamlets, and everywhere that pioneers located talk began to buzz concerning means of communication.

The Great Divide must be banded. Trade must follow the flag, and the Far Eastern ports be reached

by a more expeditious journey than the voyage round Cape Horn. It was the old dream of Columbus and the early navigators, the short route to the Indies, and appropriately, when the first transcontinental railroad was visioned, Senator Thomas H. Benton declared: "Let it be adorned with its crowning honor, the colossal statue of the great Columbus, whose design it accomplishes, hewn from the granite mass of a peak of the Rocky Mountains overlooking the road, the mountain itself the pedestal, and the statue a part of the mountain, pointing with outstretched arm to the western horizon, and saying to the flying passenger, 'There is the East! There is India!' "

For years argument was rife as to the best route for a railroad to the Pacific and gradually three came to be generally considered. One route, originally sponsored by Asa Whitney, a New York merchant and wide traveller, ran north from Chicago to the coast; the second, urged by Senator Benton, was a central line, starting from St. Louis and crossing the Rockies by a pass supposed to have been discovered by Frémont in 1848 and later located farther north in Colorado; the third, championed by Southern leaders who felt the cause of the slave states jeopardized by the other two, was to run through El Paso to San Diego.

In 1853 the Secretary of War, Jefferson Davis, sent out by order of Congress five exploring parties, officered by the government's Corps of Engineers,

for the purpose of ascertaining "the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean." The routes chosen for investigation were the Northern Trail (that of Whitney), the Mormon Trail, the Benton "Buffalo" Trail, the Thirty-fifth Parallel Trail, and the Southern Trail.

The engineers explored these routes and made full reports to the government. Their figures as to the distances and the cost of constructing railroads on these various lines were as follows: On the Northern Trail, from St. Paul to Vancouver, along the Upper Missouri,—a distance of 1854 miles,—$117,121,000; on the Mormon Trail, from Council Bluffs to San Francisco by way of the South Pass and Salt Lake City,—a distance of 2032 miles,—$116,095,000; on the "Buffalo" Trail, from Westport (Kansas City) to San Francisco by way of the Cochetopa Pass in the southern Colorado Rockies,—a distance of 2080 miles,—the cost was considered "impracticable"; on the Thirty-fifth Parallel Trail, from Fort Smith of Arkansas to San Pedro (Los Angeles) by way of northern Texas, northern New Mexico and northern Arizona to Needles at the Colorado River,—a distance of 1892 miles,—$169,210,255; on the Southern Trail, from Fulton on the Red River in southwestern Arkansas to San Pedro by way of central Texas and southern Arizona,—a distance of 1618 miles,—$68,970,000.

It was further declared that the Northern Trail

and the Mormon Trail would be very difficult to construct on account of the heavy falls of snow. The "Buffalo" Trail was ruled out because of excessive cost. The expense of establishing a terminal on the Thirty-fifth Parallel Trail that would satisfy the trade requirements of Little Rock, St. Louis, Memphis and other centres was considered such as to eliminate the use of that route. Secretary Jefferson Davis, who came from Mississippi, therefore recommended that the road should be built by the Southern Trail, which had the advantages of climate and lowest cost of construction to favor it.

Immediately the "free" states of the North took up the challenge thrown down by the "slave" states of the South. The immigration that would follow the railroad would largely determine whether the western country would be "free" or "slave," and neither of the parties to that controversy would yield to the other. Everybody took a hand in the argument. While they debated events marched apace. The Mississippi and Missouri Railroad (afterwards the Chicago, Rock Island and Pacific) was pushing across Iowa and planning to reach into the Platte Valley; the Mormons were petitioning Congress to unite Utah with the eastern states; Denver was demanding connection east and west; and the national political parties were urging that a transcontinental railroad be built by Government aid.

Citizens of California hereupon stepped forward and in June, 1861, the Central Pacific Railroad of

California was incorporated. The Civil War was in progress and the national Congress was entirely made up of Northerners; therefore the government favored a northern or central route. A bill was passed, authorizing the construction of a Pacific Railroad, and the act was signed by President Lincoln on July 1, 1862. The bill named one hundred and fifty-eight men, chosen from the Union section of the country, who should constitute, with five commissioners representing the national government, the Board of Commissioners of the Union Pacific Railroad and Telegraph Company.

These commissioners were empowered to construct a continuous railroad and telegraph line on a route that should "commence at a point on the one hundredth meridian of longitude west from Greenwich, between the south margin of the valley of the Republican River and the north margin of the valley of the Platte River, in the territory of Nebraska, at a point to be fixed by the President of the United States, after actual surveys; thence running westerly upon the most direct, central and practicable route, through the territories of the United States, to the western boundary of the territory of Nevada, there to meet and connect with the line of the Central Pacific Railroad Company of California."

The Union Pacific and the Central Pacific were given a right of way through public land of 200 feet width on either side of their tracks, and were granted as a subsidy vacant lands within ten miles on either

side of the lines for five alternate sections per mile, excepting only mineral lands. In addition to the land grant the national government made a money loan, the whole of which was not to exceed $50,000,000, and to be apportioned according to the miles of track laid.

The agreement was that the Central Pacific should build eastward from San Francisco or a near-by point to the eastern boundary of California and there join the Union Pacific. The tracks of the two lines were to be of uniform width, so that cars could be run direct from the Missouri River to the Pacific Ocean. If the Union Pacific should complete its line to the California boundary before the Central Pacific, the former company might, with the consent of the state, continue to another meeting-point; and the same privilege of continuing to build was given the Central Pacific if it reached the state boundary first.

The race was on between the two companies to see which of them could cover the greater distance with its tracks. The Central Pacific, already well organized, was first in the field.

§ II

BUILDING THE CENTRAL PACIFIC

A marvellous enterprise this was, a feat worthy to take rank with the greatest engineering projects of history. Two bands of men, starting from oppo-

site directions, were to move across plains and mountains, over arid deserts and blizzard-swept ranges and through a country where Indians were frequently on the war-path, and spin an iron thread that should link the Atlantic Ocean and Europe with the Pacific Ocean and Asia.

The voyage around Cape Horn was 19,000 miles. The journey from New York to San Francisco by the Panama route occupied between four and five weeks under favorable conditions. The Overland Stage line took seventeen days to convey passengers from the Missouri River to California. The Pony Express carried mail in eight days from the railroad end at St. Joseph to Placerville in California. Now the attempt was to be made to supplant ship and stage and horse by a track of iron rails and a steam engine.

The project was gigantic; many sensible people considered it impossible, but the history of railroads shows how frequently the seemingly impossible has been achieved. Success depends on vision, determination, and grit, and the builders of the first transcontinental railroad possessed these qualities in high degree. Five men were the driving power of the Central Pacific, five remarkable men of diverse abilities. Leland Stanford, Governor of California for two years during the Civil War, had been born on a farm near Albany, New York; his father, Josiah Stanford, had been employed on the Mohawk and Hudson Railroad when the "De Witt Clinton" pulled

its trains, and the track of that line ran past the Stanford farm. Collis Potter Huntington, a son of Connecticut, had come to California as a Forty-niner to hunt for gold; Mark Hopkins, of New York State, a pioneer adventurer over one of the northern trails, was a partner of Huntington's in the business of hardware and miners' supplies at Sacramento. Charles Crocker, born at Troy, New York, owned Sacramento's chief dry-goods store. Theodore D. Judah, of Bridgeport, Connecticut, was an engineer whose work had led him to survey the Sierra Nevada Mountains. The history of California railroads is closely associated with the names of Leland Stanford, Huntington, Hopkins and Crocker. When the Central Pacific Company—a title apparently taken from the "Central" Overland Stage road—was organized on June 28, 1861, Leland Stanford was chosen president, Huntington vice-president, and Hopkins treasurer. Theodore D. Judah was appointed chief engineer.

The road that Judah recommended—known as the "Dutch Flat" route—was a continuation of the trail that had been used by many of the Forty-niners from the Platte River and Salt Lake up the Truckee River and over the Sierra by the Donner Pass to Sacramento. This road would require the building of eighteen tunnels, most of them between 1000 and 1400 feet long, but there would be less difficulty from heavy snows than in other locations. The "Dutch Flat" route was approved, and the first spadeful of

earth was turned by Leland Stanford, then Governor of California, at Sacramento on January 8, 1863.

By midsummer of 1864 the Central Pacific had completed thirty-one miles of track to Newcastle, which represented a climb of nearly 1000 feet in the 7000 feet of ascent to the summits of the Sierra. There the work was halted. The outcome of the Civil War was still uncertain and money was not forthcoming. Charles Crocker, the contractor for this part of the line, could neither raise nor borrow funds to pay his laborers. "That was the time," he said, "when I would have been very glad to take a clean shirt and lose all I had, and quit."

He did not quit, however, nor did Stanford and Huntington and Hopkins, who toiled night and day to get the needed money, and in the following spring the track was pushed on to the emigrant station at Clipper Gap, forty-three miles from Sacramento. Congress granted the company improved conditions for issuing bonds and so obtaining funds, and the work went on more briskly. The road was now reaching into the main foothills of the Sierra and necessitated the building of tremendous trestles.

In two months the eleven miles to Illinois Town —500 feet up above Clipper Gap—was completed. At Illinois Town—rechristened Colfax in honor of Schuyler Colfax, Speaker of the National House of Representatives, who visited California in the summer of 1865—the railroad stopped that autumn while the engineers were busy with bridging, tunnelling

and trestling the route beyond. Three trains ran every day from Sacramento to Colfax; 5000 men and 600 teams were employed on the advance work in October, by the first of the new year the force was increased, there were 7000 Chinamen, paid $30 a month, who kept themselves, and 2500 white workmen, who received $35 a month and their board. The mountain sides were filled with tents, dugouts and all kinds of shacks and the roads were covered with wagons bringing food and supplies from Colfax.

In the spring the rails were thrust forward over the high, winding trestles that bridged the deep ravines as the track mounted towards Cape Horn.

Wonders had been accomplished here, the engineers had cut a roadbed in walls of granite so steep that the workmen had been suspended by ropes 2500 feet above the American River that swirled at the bottom of the cliffs. Up and up the track climbed, reaching and passing the mining camps of Gold Run, Red Dog, You Bet, and Little York. Spring freshets flooded the workings and supply-wagons toiling behind were stuck for weeks in the mud. The rails wound up around Cape Horn, and by the Fourth of July had achieved Dutch Flat.

As the Central Pacific marched through the towering mountains it built stations and water-tanks, established new towns with saw-mills to supply ties and timbers, and supplemented its rails with a telegraph line. In November it reached Cisco, fifteen miles from Dutch Flat, at a height only a little less

than 6000 feet. From Colfax the road had ascended 3400 feet in twenty-eight miles. The cost of construction of those twenty-eight miles had been $8,290,790.

Cisco was the terminus of the line for nine months while the engineers fought their way through the summits of the Sierra. The snow remained at Cisco into May; on the summits beyond, fourteen miles distant, at a height of 7042 feet, snow clung to the peaks from year to year. From Colfax to Cisco the work had been prodigiously difficult, but the next stage was an even more herculean feat of railroad building. Ten tunnels had to be constructed to bridge grades that no locomotive could climb and some of these had to be bored through granite that was almost explosion-proof. Ten thousand men worked through that winter of 1866–1867, half of them engaged in shovelling snow. A passage 200 feet wide had to be made through timber; "those are not Yankee forests," said one of the engineers, "but forests with trees four, six and eight feet in diameter." Kegs of powder blew up the stumps. It took three hundred men ten days to clear the road of timber for a mile. The expense of supplying powder mounted portentously, became $54,000 in a month. The winter was unusually stormy and the road from the advance camps to Cisco had to be kept open by a procession of snow-plows. Yet the work went on, and by the end of the year the rails stretched sixteen miles eastward from Cisco and were two miles over the divide.

The road was already doing a good freight business between Sacramento and the Nevada mines and the Overland Stage was connecting with the Central Pacific at Cisco. It had been thought by some that when the rails tapped the silver mine country by reaching Dutch Flat the company would be satisfied and go no further. That was not the intention of Leland Stanford, Huntington, Hopkins and their associates, however; they wanted to secure the business of hauling produce from the fields of Utah to market. From the California-Nevada boundary line they looked eastward and determined to fix their goal in the Salt Lake Valley, six hundred miles from where they stood.

It had cost $23,650,000 to build the railroad across California to the Nevada line. The Sierra had been conquered. In the spring of 1868 the Central Pacific had its tracks at Reno; now it moved along the lower Truckee towards the Humboldt.

Meantime what of the Union Pacific and its march from east to west?

§ III

BUILDING THE UNION PACIFIC

The Union Pacific Railroad was organized on a different plan from the Central Pacific. The Central Pacific was chartered by the state government to build in California; it was a private company and

in that capacity it had sought aid from the national government. When it accepted a loan from the United States government and became a common carrier across the California line it came to an extent under national control.

The Union Pacific was a creation of the United States government; it held a Federal charter and its route as planned lay entirely through the Territories, which were directly under the supervision of the national government. It was answerable therefore to President and Congress more directly than was its western rival.

Such a gigantic enterprise enlisted many directors and executives, but the bulk of the management presently fell to eight leaders: Oakes Ames and Oliver Ames, of Boston; Dr. Thomas C. Durant, of New York City; John Duff, of Boston; Sidney Dillon, of New York City; General John Stevens Casement and Dan T. Casement, of Ohio; and General Grenville M. Dodge, of Council Bluffs, Iowa.

The distance to be covered by the Union Pacific far exceeded that of the Central Pacific; the former was to build 1500 miles and much of that through country where there were no settlements. The entire territory of Nebraska held about 35,000 people, and from the centre of Nebraska to the Salt Lake Valley was an unpopulated waste. The citizens of the United States were not enthusiastic over buying government bonds to construct a national railroad through what they considered a desert; most of them

thought that while the road would be of some service to the nation it could never be made to pay. Again it was the dogged perseverance of a few believers that set the project to work.

The company was started in October, 1863, with General John A. Dix as president. General Dix never actually took charge, and Thomas C. Durant, the vice-president, was the chief executive and business manager. General Dodge, who, as early as 1853, had been surveying in the Iowa and Nebraska country, looking for the best route for a railroad, reported in favor of commencing the line at Omaha, a little town on the west bank of the Missouri River, opposite Council Bluffs. Railroads from Chicago were heading to Council Bluffs, and that town asserted loudly that it was the proper point of juncture between the eastern lines and the new Pacific route, but the town across the Missouri won the argument, and at Omaha ground was broken for the transcontinental line on December 2, 1863.

This occasion was celebrated with great pomp, but the track did not march forward. Money was lacking, and the national government did not come to the company's rescue until July, 1864. Then followed lengthy discussions as to the best route across the plains, so wrangled over and debated that only forty miles of track had been laid by the end of 1865. The Central Pacific was already forging out from Colfax when its rival actually began to build from Omaha. For three years the Union Pacific had

simply marked time so far as construction was concerned; now, however, it strode forward; locomotives and cars of all types came up by steamboat from St. Louis, machine-shops and saw-mills were buzzing, surveyors were exploring ahead, advance-guards were fighting Indians. The first stage of the journey was from Omaha on the Missouri to the new hamlet of Frémont.

The Central Pacific had, almost from the start, encountered mountains and gorges, peaks up which it had to crawl laboriously and by difficult grades, chasms across which it had to throw high and often curving bridges. The Union Pacific, on the other hand, had for its terrain a level country, and therefore had to spend no effort on climbing, tunnelling nor intricate trestle-building. It could march straightaway, and it did.

Surveyors rode ahead through Nebraska into Utah and the Nevada desert. Their reports decided the directors not to strike for Denver—which greatly wanted the railroad—nor to follow the Oregon and California Trail. The route determined on was in general that of the Mormon Trail.

Across Nebraska went the track-builders, past Frémont, past Columbus, ninety miles from Omaha. The Loup River was crossed by a bridge of iron 1500 feet long. Thence extended 400 miles of plains, where there were no settlements nor even cabins along the line and the only trees were in the stream bottoms.

Beyond that were the Black Hills, also bare of white men's habitations, but possessing timber; and still beyond the hills was the waterless Wyoming basin, a great barren tract stretching to the forested Wasatch. The Union Pacific might march, but it had not marched far before it found that its road was beset with as many difficulties, if of a different kind, as that of its Central rival.

The construction of the Union Pacific from Omaha to the main range of the Rocky Mountains, a distance of 700 miles, appeared to many people a comparatively easy feat, not to be compared in difficulty with the road through the Sierra. The Central Pacific, however, worked forward from a base situated at tidewater and a prosperous town; the Union Pacific built from the unbridged Missouri, a river where navigation was practicable for not much more than three months in the twelve. Supplies had to be forwarded by steamboat from St. Louis, a haul of 300 miles, or by wagon and ferry to Omaha from the railroad that was being built from Chicago across Iowa. Ties must be shipped as the Union Pacific constructed its tracks, because the only large timber in the country between the Missouri and the Black Hills was cottonwood, and cottonwood, to serve for ties, had to be treated by special zinc process. Iron, feed, provisions, these and practically everything that the builders needed must come from Omaha over the single track; the railroad began at a small river

settlement and reached out for hundreds of miles through territory that furnished no supplies for its workers.

Oakes Ames said of that part of the road which was under his direction: "To undertake the construction of a railroad, at any price, for a distance of nearly seven hundred miles in a desert and unexplored country, its line crossing three mountain ranges at the highest elevations yet attempted on this continent, extending through a country swarming with hostile Indians, by whom locating engineers and conductors of construction trains were repeatedly killed and scalped at their work; upon a route destitute of water, except as supplied by watertrains, hauled from one to one hundred and fifty miles, to thousands of men and animals engaged in construction; the immense mass of material, iron, ties, lumber, provisions and supplies necessary to be transported from five hundred to fifteen hundred miles—I admit might well, in the light of subsequent history and the mutations of opinion, be regarded as the freak of a madman if it did not challenge the recognition of a higher motive."

The Indians—the Cheyennes and the Sioux—made the work much more difficult in the buffalo country. Surveyors had to run their lines under the escort of armed guards and many a construction train was stopped and derailed by a hurricane of arrows and bullets. The red men opposed every mile of the way

through their hunting grounds and track-laying was often suspended by a pitched battle.

By December 11, 1866 the Union Pacific had built 260 miles of track in eight months, an average of more than a mile to each working day, and could claim to have constructed the longest air-line railroad in the world at that date. Now its terminal base was at North Platte, and surveyors and graders were working ahead. The next dash would be made in the spring and Chief Engineer Dodge fixed his goal 288 miles away across the Black Hills of the "Dakota" Wyoming and at the southern end of the Laramie Plains.

The surmounting of the Black Hills, although their elevation was only some 2000 feet above their base, proved a difficult problem. In railroad engineering it is customary to cross mountain ranges either by following the course of streams or by following the divides between these river-courses. Neither alternative served in the Black Hills; the streams were so winding and flowed through such deep canyons that tracks could not follow them, and in the divides rocks thrust forward at such angles as to bar passage and even to defy tunnelling.

Engineers, however, had reported that the route through the South Pass—the Oregon and California Trail—was impracticable, as were also the snow-filled passes from Denver; so through the Black Hills the railroad must go, if it was to go anywhere. In

the spring of 1865 General Dodge, leaving most of his expeditionary party at Lodge Pole Creek, east of the Black Hills, set out with a few engineers to explore the range for himself. The Sioux were on the watch, and, galloping between him and his base-column, drove him to a long ridge that crossed the hills. There the general's party fought the Indians off and made their way along the ridge to signal to the soldiers below on the creek.

By nightfall the troopers came up to the rescue and the whole party rode down the ridge to the plains. To one of his men General Dodge said: "If we save our scalps I believe we have found the crossing of the Black Hills."

The scalps were saved; Dodge marked the foot of the grade he had located from the vantage ground of the ridge by a lone tree; the next year engineers ran a line up the ridge, and there a ninety-foot grade was established that reached almost unbroken from the plains to the summit; Lone Tree Pass it was first called, and later rechristened Sherman Summit in honor of General William T. Sherman.

The spring dash of 1867 started. Seventy miles of track were laid in two months; the Union Pacific was at Julesburg, 377 miles from Omaha. The advance guard located the next division point at Crow Creek in Wyoming and gave that end of track the name Cheyenne. Here engineers and soldiers had a fight with Cheyennes and Sioux, who were attacking a Mormon grading party. The Indians were driven off,

but kept on the warpath, looking for white men's scalps.

The grade to Cheyenne had not exceeded thirty-five feet to the mile; from there the rails could climb to Sherman Summit in the Black Hills, thirty-two miles, by a grade of ninety feet. Here coal was to be obtained for fuel, timber for ties and bridges, the rock of the hills for grading. By mid-August the track was out 430 miles from Omaha; 125 miles had been built in four months; the work could now progress as fast as materials could be supplied.

On that march across the plains an army had been employed; 3500 men made up the grading gangs, 450 laid the tracks, and the crews that ran the construction trains numbered 300. Along the line as it pushed forward towns sprang up overnight, towns with machine shops to supply the railroad and with shops of various other sorts to accommodate the settlers, boomers, gamblers, speculators, who followed the builders. World's records were made; two and one-half miles of track were constructed in one day, and 150 miles in 100 consecutive days. General John Stevens Casement, known familiarly as "Jack" Casement, was acclaimed as "the champion track-layer of the continent," and earned the title by working like a Trojan with his Irish crews. The work was carried on with military precision; it was said that General Casement's track train "could arm a thousand men at a word; and from him, as a head, down to his chief spiker it could be commanded by ex-

perienced officers of every rank, from general to captain."

The rails entered Cheyenne November 13, 1867, and the Union Pacific was 517 miles west from Omaha. Cheyenne was to be an important town, the junction point for Denver, from which another railroad, the Denver Pacific, was afterwards to build north. The Black Hills beckoned; but winter storms set in early and track-laying was halted. The total march for 1867 stood at 240 miles.

Across the Rocky Mountains went the boast of the Union Pacific builders that they would reach the California border before the Central Pacific reached the Nevada line. To this Charles Crocker of the Central responded with the announcement of what his company would do: "A mile a day for every working day in 1868."

That declaration roused the Union builders. From Sherman Summit in the Black Hills stretched some 500 miles of desert and mountains to the Salt Lake Valley. The Central Pacific had still some 600 miles to go, the most of it over a desert. The Central had won through the mountains, but the Union had steep ranges yet to conquer; it looked as if the Central would win the race.

Another difficulty confronted the Union Pacific, the question raised by the Mormons. The surveys the railroad engineers had made west of the Rockies had decided that it would be impracticable to build the road by the route south of the Salt Lake, by Salt

Lake City, to the Humboldt country and the California boundary. The best route lay north of the lake. But to take this road would antagonize Brigham Young, ruler of the Mormons, who wanted the railroad to enter his city, the centre of the only thriving and rich community between the Missouri and the Sierra.

The Union Pacific was in a dilemma; should they risk Brigham Young's displeasure? His hostility could do much to impede the progress of the railroad through Utah; on the other hand, to the railroad that entered Salt Lake City he would give great material assistance and the backing of the Mormon power.

To secure the railroad for his city President Brigham Young announced that he would furnish labor to grade 200 miles east and west of the Salt Lake. Would the Central Pacific take advantage of the offer? That was what the Union directors wondered. Great was their satisfaction when the engineers of the Central filed their report favoring the route by the north end of the lake.

Brigham Young protested for the Mormons, declared that it had been the people of Salt Lake City who had been among the first advocates of a transcontinental railroad which should put them in communication with the east and west. Mormons urged their cause in Washington. The national government, however, accepted the northern route recommended by both the Union and the Central; and, that mat-

ter decided, Brigham Young, making the best of the situation, turned his attention to earning profit by furnishing workmen and supplies to the Union Pacific.

During the winter the Union Pacific made their plans for the great dash to be started with early spring. They must build their track to Ogden; their ambition was to get so near the California boundary that when the two lines met they would control the traffic and shut the Central out from the Salt Lake Valley. An immense army of laborers was collected; there were 10,000 graders and track-layers in Cheyenne and 1000 men were at work in the Black Hills cutting timber for ties and bridges. From Sherman to Ogden 480 miles of rails were to be built at top speed.

With the opening of spring in 1868 the rival railroads girded their loins for the final dash.

§ IV

THE RACE TO THE GOAL

Government subsidies and land grants were the prizes for which the rivals contended. Westward across Wyoming and Utah went the Union, eastward across Nevada came the Central. The orders the Union directors sent Chief Engineer Dodge in April were "to cover the road with men from Green River to Salt Lake within one month, and to Humboldt

Wells in three." That meant that 700 miles must be located by August.

The march was begun to Ogden, a march that halted neither for desert nor mountain, heat nor cold. General Dodge declared: "I do not hesitate to say that over half the number of miles of line was never located before in the same time by the same force—especially when it is remembered that the line between Green River and Salt Lake (the mountain portion) was difficult, requiring long and careful study. In Eastern States, with the same force, it would have been considered a quick location if made inside of a year."

The plan of crossing the northern arm of the Great Salt Lake was abandoned on account of the depth of the water and the muddy bottom. The railroad must make a detour from Ogden to the north of the lake and climb the steep Promontory Ridge. Beyond the ridge was a desolate, muddy basin, of no value as cultivable land; but for each mile of track across it the company would receive the government subsidy of $64,000, and gain a proportionate share of the receipts from transcontinental traffic.

The spring was late and it took a month for the end of track to reach Laramie, twenty-three miles from Sherman Summit. In two months it had gone 120 miles farther to Benton. Two miles a day had been the pace from Laramie. Graders were working 250 miles ahead, 10,000 laborers with 500 teams. Construction trains were steadily puffing westward over

the single track from the Missouri River; forty carloads of material were required for every mile of track laid; wheels must turn night and day to supply the sinews for the race.

The Union Pacific army built its iron rails across the Red Desert under the scorching sun of August, then climbed the wide plateau of the Continental Divide at an altitude of 7164 feet, and went on into the Bitter Creek basin, a territory shunned by travellers and explorers. Alkali dust filled the air, for 100 miles the water was poisonous with alkali and salt, in many sections there was no water. To quench thirst the workers drank the brackish supply hauled from the least poisonous source by wagon or in tank-trains. Yet on they pushed and on, and by the twentieth of September the Bitter Creek country was behind them.

General "Jack" Casement's track-layers—most of them Irish, and as indomitable as their leader himself—worked as fast as the graders made the road ready for the rails. They laid three miles in a day, four in a day, five in a day; only when they overtook the graders or materials were slow in arriving from the rear did they halt. The eyes of the whole country were on them; everywhere the chief topic of discussion was the progress they were making; the newspapers of the eastern cities carried daily headings: "One and nine-tenths miles of track laid yesterday on the Union Pacific Railroad"; "Two miles of track

laid yesterday on the Union Pacific Railroad"; "Two and three-quarters miles of track laid yesterday on the Union Pacific Railroad." The telegraph went with the rails and every mile of that wonderful march across the barren lands was reported and read by thousands on the Atlantic seaboard.

By the Overland telegraph wires the Union and the Central Pacific were each kept informed of the rival road's progress. General Casement's men laid six miles of track in one day; Crocker's track gang accepted the challenge and built seven miles in one day for the Central. General Casement laughed and swore that his Irishmen would beat the rival's Chinamen. He had a number of guests at his camp at Granger, and at sunrise he invited them out to see what his marvels could do. That day the Union Pacific laid seven and a half miles of track, lacking a few rail-lengths. Casement vowed that he would build eight miles, if Crocker continued the contest.

Crocker's answer was: "The Central promises ten miles in one working day." To himself he made the reservation: "But we will take our time to it."

The telegraph brought this answer to Vice-President Durant of the Union Pacific at his New York office, and he sent word back: "Ten thousand dollars that you can't do it before witnesses."

"We'll notify you," was Crocker's reply.

Casement's men sprang forward. Their slogan was the song:

"Drill, my paddies, drill!
Drill, you tarriers, drill!
Oh, it's work all day,
No sugar in your tay—
Workin' on th' U. Pay Ra-ailway!"

Ties were laid, rails were spiked down; two rail-lengths to the minute, 400 rails to the mile. Small time was given to ballasting the ties and little attention to whether the rail-joints measured evenly with the ties or hung between them. Winter was coming, already the first snows were falling in the Wasatch. From Granger the track leaped to Piedmont and the Union Pacific was on top of the Uintah Chain of the northern Wasatch range.

Here the Mormons proved of great aid. At the order of President Brigham Young,—who took a contract to build the grade from the head of Echo Canyon to Promontory Summit, a distance of 120 miles, for $2,000,000,—his people joined the forces of the railroad and pushed the work forward with satisfying speed. Over the heights of the Wasatch and down through the mountain passes the rails forged ahead through drifting snow; at the end of the year the winter terminus was at the camp of Wasatch, 966 miles from Omaha.

Ogden was sixty-five miles away. Over the desert beyond the Central Pacific was pushing, striving to win as much land as it could from its eastern rival. Crocker had kept his promise of building a mile a day. The Central tracks had reached Reno May 1,

1868, and crossed the Truckee on the ninth of July. From there extended the deserts of Nevada and Utah, alkali, rock-filled regions, with uncertain water-courses. It was rumored there were Indians lurking back of the peaks that alone broke the desert. Crocker exhorted his white and Chinese laborers,—2000 white, 10,000 Chinese,—and tackled the job. There were three canyons to be graded, the grading was completed when the track-layers arrived. Now, as the Central proceeded across that uninhabited land everything that was needed had to be brought great distances, the vast army on the march looked back across the mountains for all its supplies.

At the end of the year the Central rail-heads were almost at Humboldt Wells, the emigrant station that the Union Pacific had claimed as its outpost. Between the winter terminals of the rival lines stretched 300 miles, desert, mountain and valley, through which the rival grading crews were working in opposite directions, often side by side. The Union Pacific track was still 275 miles from Humboldt Wells; the Central held the upper hand, it could reach that station in a fortnight and dash for the Salt Lake Valley, there to meet not only the rival line but the Central's own grade from Ogden.

Moreover the Union was now in the snowdrifts of the mountains, the Central in the less stormy lowland country, though even there the winter winds were cold. The Central builders leaped forward to Humboldt Wells; Mormon laborers were now with

them; over the desert from the Sierra came the supply-trains.

If the Central would build through the winter, so would the Union, and the latter's workmen fought through blizzards and were only idle when storm or snow prevented the arrival of materials. In one place the track-layers could not wait for the clearing of a grade and the rails were laid upon ice, with the result that a train slid sidewise into a canyon, bringing down with it the ties and rails.

In January, 1869, the Union Pacific track had won to a point 1000 miles from Omaha. Ahead the Union's grading gangs were working out from Ogden on the 220 miles that stretched to Humboldt Wells. Into Ogden came the Union's rails on March third, welcomed by the inhabitants of that small Utah settlement. There was a parade, with a military brass band, and a banner proclaiming: "Hail to the highway of nations! Utah bids you welcome."

The whole country, that had been watching the great race with rapt attention, was now wondering where and how the contest would end. Replying to a question from Congress, the Secretary of the Interior said: "The point of junction has been assumed to be 78.295 miles east of Salt Lake City, or at a point that will entitle the two companies to an equal amount of bonds." The Union Pacific had, however, already gained and passed the mark set by the Secretary of the Interior and was in Ogden. It was evident that the railroad could not get as far as Humboldt

Wells, but the company intended to push westward from Ogden as far as it could, and for that purpose now called in its grading-parties in the Nevada desert and set them to work in the Utah country.

The Union headed northwest around Salt Lake, making for the ridge to Promontory Summit. This ridge had no ravines nor water-courses, and had to be reached over shifting mud and by means of curving trestles and switch-backs. Meantime west of Promontory Summit the Central was building mile after mile across the desert. To reach the Summit the Central had the easier route. The Union battled sturdily, track-layers spiking the rails close behind the graders and the trestle-builders. A terminal camp at Corinne was located on March twenty-eighth; the pace from Ogden had averaged a mile of track a day. On the other side of the Summit the Central was doing as well through the desert.

Each of the two railroads was claiming territory far ahead of its tracks; the Union had won Ogden and the trade of Salt Lake City and had surveyed as far as the California border; the Central had graded east of Ogden and run its survey across the Wasatch; the lines met nowhere; if there was to be a through transcontinental road the rivals must compromise. This the companies agreed to do, and the compromise, as ratified by Congress, read as follows:

"That the common terminus of the Union Pacific and the Central Pacific Railroads shall be at or near Ogden; and the Union Pacific Railroad Company

shall build, and the Central Pacific Railroad Company shall pay for and own, the railroad from the terminus aforesaid to Promontory Point, at which point the rails shall meet and connect and form one continuous line."

This agreement reached, the Union Pacific climbed Promontory Summit and on April twenty-eighth looked down on the camp of the Central Pacific westward on the plains. The grades joined at Promontory, a small railroad settlement. The great work was almost finished. Charles Crocker of the Central sent word to Durant of the Union: "To-morrow we'll lay those ten miles."

When those ten were built there would be but ten more between the two roads and of these the Union Pacific was to lay six. Holiday was declared to celebrate the joining of the lines.

V

THE COMPLETION OF THE LINE

At seven in the morning Crocker gave the signal. Ties had been laid in advance, five trains, loaded with spikes, rails, bolts and fastenings, stood on the track, and trucks carried the materials forward. Two squads, each of four workmen, caught up a pair of rails and placed them on the ties; spikes, fishplate fastenings and bolts followed, and the rails were instantly laid. On the heels of the layers came other

workmen, armed with pick and shovel, to ballast the roadbed. The Central was marching forward at the rate of 144 feet—or five pairs of rails—to the minute.

With marvellous precision truck-crews, rail-carriers, track-layers, and ballasters did their work. Six miles of the ten had been laid by 1:30 o'clock—breaking all previous records—and Crocker ordered a recess for rest and dinner. An hour later work was resumed, and by seven o'clock in the evening the ten miles of track, and 1800 feet more, had been completed. Crocker had won his wager before some 5000 witnesses.

That feat of the Central Pacific was a unique achievement and made a record for track-laying that has never been approached. Some of the Union Pacific forces claimed that they could surpass the ten-mile record, but Crocker had seen to it, when he planned his exhibition, that his rivals should have less than ten miles to build, and therefore no attempt was made to win the palm from his gallant men.

On the following day the two railroads, working easily, laid their rails to the meeting-place. May first the two lines were separated by only a pair of rails each. West the tracks ran 690 miles to Sacramento, east 1086 miles to Omaha.

The completion of the transcontinental line took place on May 10, 1869. The little town of Promontory, Utah,—a collection of canvas tents and board shacks along a single muddy street,—was crowded

with railroad workers, soldiers, speculators, and visitors from east and west. To the south rose the plateau of Promontory Summit, from which there was a splendid view of the vast Salt Lake. The tracks met in a flat-bottomed valley, sparsely covered with sage brush and scrub cedars.

There excursion trains pulled in over the two lines, and special trains with the officials of the companies. There was an interesting difference between the locomotives—the Jupiter–60 of the Central and the Rogers-119 of the Union; the Central engine had a great flaring funnel stack, the Union locomotive a straight, slender stack topped by a spark-arrester cap. The official party proceeded to the gap between the rails, where a detachment of infantry kept the crowd in place.

Music was furnished by a band from Salt Lake City; there were reporters from eastern and western newspapers, and the telegraph wires were run from a pole to a small table close to the track to expedite the sending of despatches. One line of rail had already been completed, only the south ends of the ties were to be joined with pomp and ceremony.

The construction superintendents of the two lines brought a tie from the car of President Leland Stanford of the Central. This, romantically designated the Last Tie, was of polished native mahogany or laurel, eight feet in length, bound with silver and adorned with a silver plate, on which was recorded, "The Last Tie Laid on the Pacific Railroad, May 10,

Linking the Continent, Promontory Summit, Utah, 1869

Indians Attacking Union Pacific Workers, 1867

Courtesy of the Union Pacific Railroad

1869," and the names of the officers and directors of the Central Pacific. Two rails followed, that of the Central carried by Chinamen, that of the Union by an Irish squad. The ceremonies began with a prayer by the Reverend Dr. John Todd, of Pittsfield, Massachusetts; then there were several speeches.

President Stanford, of the Central, declared in the course of his remarks: "The day is not far distant when three tracks will be found necessary to accommodate the commerce and travel which seek a transit across this continent. Freight will thus move only one way on each track, and at rates of speed that will answer the demands of cheapness and time. Cars and engines will be light or heavy, according to the speed required and the weight to be transported."

Chief Engineer Dodge spoke for the Union Pacific. Said he: "Gentlemen, the great Benton proposed that some day a giant statue of Columbus be erected on the highest peak of the Rocky Mountains, pointing westward, denoting this as the great route across the continent. You have made that prophecy to-day a fact. This is the way to India."

There were cheers and more cheers. Various spikes were then proffered to the officials; Nevada presented a spike of silver from the Comstock lodes; Arizona one of alloy, gold, silver and iron; Idaho and Montana spikes of silver and gold; California two of gold. Dr. Harkness made the presentation for California. "From her mines," he said, "she has

forged this spike, and from her woods she has hewn this tie, and by the hands of her citizens she offers them to become a part of the great highway which is to unite her with her sister States on the Atlantic. From her bosom was taken the first soil, so let hers be the last tie and the last spike."

The spikes were driven in by various guests, President Stanford and Vice-President Durant drove in the historic last spike, and over the wires the message leapt to all four quarters of the nation where in city and village bells rang and cannon thundered and crowds paraded the streets.

The two locomotives, the Central's Jupiter-60 and the Union's Rogers-119, were unhooked from their passenger-cars, and covered with cheering riders steamed forward until they touched. There bottles of champagne were broken on the opposite pilots while the engineers shook hands. The locomotives backed away and each hooked up its cars; then the Union train smoothly crossed the juncture of the rails; when it withdrew the Central train puffed over the completed line.

The next day, May eleventh, the first transcontinental railroad passengers journeyed over the finished track.

Congress had directed that the common terminus of the two lines should be "at or near Ogden." The Union Pacific, however, had built its tracks 53.56 miles west from Ogden to the juncture at Promontory. The Central Pacific wanted to reach Ogden, and

a bargain was made by which the Union sold about 50 miles of this track and leased the balance to the Central, so that the Central could run its trains into Ogden.

The Central took over the Western Pacific, one of its subsidiaries, connecting Sacramento and San Francisco, in 1870, and thereby completed the all-rail route from San Francisco to New York.

8

GREAT RAILROADS OF THE WEST

§ I

THE SOUTHWEST

THE railroads of England in general followed highways of travel already well established and linked town with town for the greater convenience in business and pleasure of the inhabitants; those of the United States, except in the strip of territory adjacent to the Atlantic coast, preceded the settlement of the country, marked the routes along which industry was to build, and were the pioneers of the nation's development. The land along the line of the first transcontinental railroad quickly rose in value, towns sprang up in the wake of the locomotives, and, although some of these were what were known as the "roaring towns" of the west, that quickly boomed and as quickly burst in sky-rocket fashion, many became thriving, important cities.

An era of prosperity followed the Civil War and the nation's attention was called to the vast natural resources of the western country. Oil fields and gold fields beckoned, grain production doubled, trebled west of the Mississippi, and this golden opportunity to reap rich harvests from the mining and agricultural regions led to tremendous competition among railroads.

Chicago was an important railroad centre before the Civil War, lines from there had reached the Mississippi and pushed on towards the Missouri. The first railroad completed across Iowa was the Chicago and Northwestern; when it established its terminus at Council Bluffs it had direct connection with the Union Pacific and a commanding position in transcontinental traffic. The second line to reach the Missouri was the Chicago and Rock Island, afterwards known as the Chicago, Rock Island and Pacific, which brought its tracks to Council Bluffs in June, 1869. Later in the same year there arrived the Chicago, Burlington and Quincy, and these three great roads, each controlling a number of smaller lines, engaged in a battle of giants for western business. A fourth road to Council Bluffs was the Chicago, Milwaukee and St. Paul, which did not, however, reach that important junction-point until some time after the first three. Meanwhile the Illinois Central was building across Iowa to Sioux City, and the Pacific Railroad of Missouri, subsequently the Missouri Pacific, to Kansas City.

What of that vast territory west from the Missouri and the Gulf of Mexico to the Pacific Ocean? In New Mexico, near a tributary of the Rio Grande, was a settlement founded by Spanish friars and called by them La Ciudad Real de la Santa Fé de San Francisco, The True City of the Holy Faith of Saint Francis. Here were rich deposits of gold, silver, copper, iron, and salt, as well as fields of maize, wheat and fruit trees, and early in the nineteenth century American traders established a caravan route across the prairies from Kansas to Sante Fé. The trail was infested with Apaches and other warlike Indians, but the profits of Santa Fé business were increasingly large and more and more tempted eastern merchants.

When Mexico ceded to the United States in 1848 the great southwest territory between the border of Texas and the Pacific an impetus was given to trade with that section and there was talk of binding it to the east and middle west by railroads. Colonel Cyrus K. Holliday was the leading enthusiast in the project of railway development in the southwest and visioned a line across Kansas to Santa Fé, with branches north to Denver, west to San Francisco, and south to the Gulf of California. His friends ridiculed this idea, declaring that such a railroad system could not possibly be made to pay, and therefore Colonel Holliday contented himself with organizing a company to run a line between Atchison and Topeka in Kan-

sas. This company was chartered in 1859 as the Atchison and Topeka Railroad.

Funds to build this railroad were difficult to obtain and the company marked time until Congress granted the owners ten square miles of land for every mile of track that should be laid through Kansas to its western boundary. This extension of the road was in line with Holliday's plans and through his influence the name of the company was changed in 1863 to the Atchison, Topeka and Santa Fé. Building at length began, and the rails pushed across the wide fields of Kansas and through the buffalo country, where workmen hunted the great shaggy beasts and possessed themselves of thousands of hides.

The railroad did not stop at the Kansas line, it went on into Colorado, turning a little to the southwest to make for the Raton Pass through the Rocky Mountains. Here it encountered a rival; Denver, which had been left out from the route of the Union Pacific, was building a line of its own, the Denver and Rio Grande, and claimed Colorado as its territory. The two roads raced for the Raton Pass. The Santa Fé engineers arrived first by a few hours, started shovelling while their competitors slept, and by morning had established their title to the route through the pass.

From Raton Pass the Santa Fé ran almost directly south. On reaching the border of New Mexico

a tunnel had to be constructed at a height of nearly 7600 feet through half a mile of mountain. Beyond that the tracks dropped through a winding pass into wild and magnificent country, a land of forests, of deep, rock-walled canyons, of sage-covered deserts, of mesas, buttes, extinct volcanoes and lava beds. The first train steamed into New Mexico in 1878; in 1880 Santa Fé was reached. The railroad linked up Albuquerque that same year and fifteen months later was at El Paso, Texas. In 1883 the Atlantic and Pacific Railroad united Albuquerque with the Pacific, and by that junction supplied another through rail route from Chicago to the western ocean.

The Santa Fé is a most interesting road. It was early very profitable, due not so much to the trade with Santa Fé, for which it was originally planned, as to the traffic in cattle. The railroad crossed all the north and south cattle trails farther south than any of its rivals and so secured a great advantage in cattle-shipment east from Colorado and Kansas. In addition the Santa Fé built up Kansas, bringing settlers to it and making it one of the richest agricultural areas in the world. More than this, it has opened the mineral deposits of Arizona. Its tracks, which reach for 11,000 miles, traverse country unrivalled for beauty, of a grandeur and picturesqueness nowhere else to be found. Its crowning wonder is the Grand Canyon of the Colorado, made accessible to travellers by a northern branch from the main road.

The Colorado River is bridged by the Union Pa-

cific at Green River Station, and 400 miles lower down by the Atchison, Topeka and Santa Fé at Needles. Here the Santa Fé tracks pass across the Mojave Canyon on a huge cantilever bridge, the second largest in the world, and enter southern California. The country through which the road runs is divided by the San Bernardino Range; to the north is the Mojave desert, rocky and bare of all but the most hardy plants, yet rich in minerals; to the south lies the "Land of the Afternoon," a domain of great beauty and fertility, famous for its flowers and citrus fruit.

Without the railroad to distribute quickly the fruit of California, a perishable commodity, the country around Los Angeles would not have prospered as it has; conversely, the railroad would not so greatly have prospered but for the fruit trade. Take into consideration the route of the Santa Fé, bringing to market the cattle and grain of the Kansas prairies, the ore of the mountain districts, and the oranges and lemons of the Sunset Land, and it is easy to see how important this great railroad system has been in building the nation.

In the west, as in the east, railroads, originally competing with each other for the business of a certain section of country, tended to consolidate and become parts of a system, the smaller lines dominated by the most powerful company. Among a number of railroads one would become the chief and either by purchase or lease or some arrangement with

the other roads would acquire access to the strategic points in the territory it served. So it was that the Santa Fé by adding this and that branch to the parent stem stretched across the southwest to the Pacific. So also that other great southwestern railroad, the Southern Pacific, built up its empire.

The Southern Pacific was made of various lines. After the completion of the first transcontinental road by the joining of the Union Pacific and the Central Pacific at Promontory the Central Pacific ruled California. To hold all the traffic of that state the Central built a southern extension under the name of the Southern Pacific of California. Collis P. Huntington was president of both lines. To head off competition it pushed its tracks to Yuma on the Colorado River, a place of great importance in the control of southern California.

From Yuma it presently built east, and then by making a junction with the Galveston, Harrisburg and San Antonio the Southern Pacific obtained a through route from San Francisco to New Orleans. The management of the various branches by the joint Central Pacific-Southern Pacific proved complicated, however, and therefore a new charter was obtained to incorporate the Southern Pacific Company of Kentucky. This new Southern Pacific leased all the properties of the Central Pacific and with its connections to New Orleans and Galveston became the longest of all the American railroad systems and

the great rival of the Santa Fé through the southwest to California.

The Southern Pacific tracks crossed the deserts of southern Arizona, New Mexico and Texas; between Colton in California and Del Rio in Texas stretched 1200 miles of sand. Water had to be carried for men and engines in some places as far as 200 miles. Frequently the rails were covered by sand in the high winds of the desert and had to be dug out before the locomotives could proceed. For months at a time track-laying was suspended because of the intense heat that made it impossible to handle tools. There were no snow-slides to be met, as had been the case in building the Central Pacific, but the blowing sand was scarcely less of an obstacle, and the miles on miles of sand-fence of the Southern Pacific matched the miles of snow-sheds on the northern road. At the Tehacape Pass the height to be overcome was so great that eight miles of track had to be laid in order to gain a distance forward of one and a half miles. Once-and-a-half around the height the rails curled, then doubled on themselves and for a considerable distance ran straight back towards their starting-point, an instance of engineering cleverness and audacity.

A mighty feat of railroad building, that of the Southern Pacific across the desert. The results justified the labor. An immense traffic sprang up between San Francisco and Galveston and New Orleans. Sugar from the Sandwich Islands, landed on

the Pacific coast, was whirled across country to Galveston and there shipped to New York; fruit from the far western orchards, conveyed by express to New Orleans, was carried by the Illinois Central to Chicago and other cities along its route; and in time even the desert places, thanks to irrigation, contributed their share to the railroad's freight.

§ II

THE NORTHWEST

Several of the routes across country to the Pacific that were originally urged for the first transcontinental railroad were later approximated by the lines of the Santa Fé, the Southern Pacific and the Northern Pacific. The Union Pacific, partly owing to the fact that it was the first through road to be built, partly owing to its central position geographically, was for some time the most important route in the west; then south of it and north of it rose other ambitious lines.

California was not the only desirable goal on the Pacific coast, there was the seaboard of Oregon and Washington, and to connect the Mississippi River section of the country with the far northwest corner the Northern Pacific Railroad was projected to run from Lake Superior to Portland, Oregon. The route planned for this line presented no exceptional engi-

neering difficulties; the main objections to it were that it ran through a very sparsely settled territory and that the climate of this territory was very cold. Construction work on the line was begun at Pacific Junction in 1870 and in three years the railroad was completed as far as Bismarck, North Dakota. To secure a connection with Duluth and St. Paul the Lake Superior and Mississippi Railroad was leased and a traffic agreement was made with the St. Paul and Pacific Railroad. At the western end of the line the Northern Pacific acquired an interest in the Oregon Steam Navigation Company.

The obstacles encountered by the Northern Pacific were largely financial; when funds could be obtained the laying of tracks through North Dakota and Montana went on, when the road's bankers were in difficulties the work stopped until money was easier. Not until 1883 was the last spike driven by this pioneer railroad of the Northwest. Then the Oregon and California Railroad was leased to furnish a direct line from Portland to San Francisco. In 1887 the Northern Pacific completed its tracks to Seattle, which became its main western terminus.

Meantime the St. Paul and Pacific Railroad was adventuring in the northwestern section of the country. This road was in large part the creation of James J. Hill. When eighteen years old he was an employé of a forwarding business between the United States and the Hudson Bay Company. Presently he went into business for himself and by his

travels became well acquainted with the country in the vicinity of Lake Superior and the Red River, and realized the great possibilities for railroad traffic through the wheat districts. Taking a position with the St. Paul and Pacific Railroad, he won his way to influence and power.

Presently the connection between the St. Paul and Pacific and the Northern Pacific was abrogated and Hill saw an opportunity to obtain the former road for himself. He interested Canadian capital and reorganized the St. Paul and Pacific under the new name of the St. Paul, Minneapolis and Manitoba, with himself as general manager. The main purpose of the new company was to connect with the Canadian Pacific, which was then being built, but the country more directly west was not overlooked, tracks were laid to Fargo and Grand Forks and pushed across the Dakotas.

Buying the stock of the company as rapidly as he could, Hill gained control of the road in 1883 and became its president. By then the company's two northern lines had reached the Canadian border and the western division was at Devil's Lake in North Dakota. By 1890 Hill's road owned more than 3000 miles of track; now his ambition was to reach the Pacific. With his engineers he travelled over every mile of the route he planned and suggested the best places for the rails. He completed his junctions with the Canadian Pacific, consolidated other railroads with his, changed the name of his company to the

Great Northern, and finished his through route to Seattle in June, 1893. For a time there was great competition between the Great Northern and the Northern Pacific, but presently agreements were made, and the two roads worked in harmony. Into the northwest they brought a steady stream of settlers, and local as well as through traffic has made both roads prosperous.

Another giant railroad system that has spread its network of connecting lines and spurs over the northwest is the Chicago, Milwaukee and St. Paul, which links up Chicago with Kansas City, Omaha and Sioux City in one direction, with Milwaukee, St. Paul and Minneapolis in another, and with Spokane, Seattle and Tacoma in the far west. This railroad has accomplished a remarkable feat of engineering in electrifying 660 miles of its tracks across the Belt, the Bitter Root, the Rocky, and the Cascade Mountains to shipside on Puget Sound. The power employed is generated from the great hydroelectric resources of western Montana and Washington. The power units are capable of moving passenger trains of twelve to fourteen cars over steep grades and in exhibition tests have accomplished a speed of 83 miles an hour.

Various tests have been made by this road to determine the relative powers of its electric and steam locomotives. On one occasion a gearless electric engine, weighing 520,000 lbs., was set buffer to buffer against a freight engine, weighing 556,000 lbs., and

the locomotive drivers were told to push their engines against each other as hard as they could. The freight locomotive snorted under full steam, the motors of the electric hummed; for a few seconds the two stood locked tight, then the electric locomotive propelled its rival backward on the track.

9

AN ADVENTURE OF THE CIVIL WAR

THERE is a Civil War story of a captured locomotive that is celebrated. Early in the war Confederate troops held the eastern section of Tennessee, including the city of Chattanooga, which was an important strategic point. A railroad ran through Georgia to that city and to protect the line of communication Confederate soldiers guarded the tracks for two hundred miles. If Union forces could destroy the tracks Chattanooga, isolated from support by the south, could be taken by a small detachment of Northern troops; but to capture the railroad would, it seemed to the Union commander, require a good-sized army, and there was no such army available for that purpose.

Such was the situation when on an April evening in 1862 a young man, James J. Andrews, well known as a clever scout, sought an interview with the Union commander in central Tennessee, General O. M. Mitchell. To this officer Andrews said: "General, if you will let me have twenty-four soldiers, I will cap-

ture a train, burn the bridges on the Georgia railroad and cut off Chattanooga from the south."

"That's impossible," Mitchell said shortly.

"Isn't it worth trying, sir?" Andrews argued. "If my plan fails we lose only a handful of soldiers; if it succeeds the whole of Tennessee is ours."

General Mitchell considered for some moments and then agreed to give the scout the men he asked for.

Twenty-four men were offered the first chance to volunteer for secret and dangerous service and each accepted. Each was given the camp countersign and a special countersign by which they might recognize the others of their party. They were told to meet at sunset the following day at a point a mile below the encampment and wait there for Andrews. This they did, and the scout led them by a winding path to a thicket in a small ravine. There he told them his plan: to capture a train from the enemy and run it two hundred miles through Confederate territory. They would have to pass other trains while they were occupied in tearing up tracks and burning two bridges. He pointed out that they might be shot and, if taken prisoner, would probably be hung as spies. Any who did not care to make the venture might yet withdraw.

All the band agreed to follow Andrews. He then went into details. The soldiers were to wear Confederate uniforms and carry no arms except a revolver and a bowie-knife apiece. From camp they

were to go to Chattanooga on foot and from there, boarding a Southern train, ride to the little town of Marietta in Georgia. If anyone questioned them they were to say that they were Kentuckians going to join the Confederate army. In Marietta they would take rooms at the hotel and meet in the leader's room at two o'clock on Saturday morning.

At the time set nineteen of the twenty-four reported to Andrews at the Marietta hotel. One of the others had been delayed by a wreck, two had been obliged to enlist in the Confederate army, and the remaining two, though they reached Marietta, through some mistake did not join the party at the hotel. The leader gave them further orders, and the nineteen went to their rooms to sleep until daylight.

Early in the morning all were at the railroad station before the arrival of the northbound mail train. Each bought a ticket for a different station along the road in the direction of Chattanooga. Some eight miles from Marietta there was a small station, Big Shanty, with a freight-house and one or two dwellings, nestled at the base of Kenesaw Mountain, and at this place, where he thought there would be few people, Andrews had planned to capture the train.

Picture the astonishment of the leader and his men when they saw from the windows of the cars on which they were riding to Big Shanty the white tents of a regiment of Confederate soldiers camped near the road! The little Union band would have to capture the train in full view of a detachment of the

enemy! The train stopped at the station and engineer, fireman and conductor, together with the passengers, hurried into the restaurant for breakfast. Andrews and his men hung behind. In his party were two who had been engineers and one who had been a fireman; these three, unobserved, went forward and commenced to uncouple the locomotive—a wood-burner, christened ''General''—with its tender and three baggage-cars. Meantime the others stood around, hands on their revolvers, and shielded the three from Confederate sentries stationed along the tracks.

At length the men freed the cars and the two engineers and the fireman jumped up to the locomotive cab while the others sprang into the baggage-cars. Andrews stood on guard, not yet aboard the train. The enemy sentries appeared surprised at the sight of so many men climbing into the cars, but one of the Union party called out to the Confederates that they would be back as soon as they had taken some other cars on at the siding.

When his men were all aboard Andrews followed them and gave the signal to start. The engineer in his excitement pulled the throttle wide open and for a moment or so the wheels spun round and round without gripping the rails. Then he slowed and the locomotive started off with a sudden jerk that threw the car-riders off their feet. Away went the engine and baggage-cars just as the train's former crew

ran out from the dining-room and shouted to the sentries to stop the thieves.

The train had been successfully captured; now it must be run through two hundred miles of hostile country and past all the trains it might meet from Big Shanty to Chattanooga. To succeed in this Andrews must prevent any news of the capture being forwarded along the line. Big Shanty had no telegraph station, but word could quickly be sent to the telegraph office at Marietta. After a dash of four miles therefore the locomotive was stopped and one of the party climbed a telegraph pole and cut the wires. Others tore up one of the rails and hoisted it into a baggage-car while dry railroad ties were being loaded to be used in burning bridges. On again they went; obliged presently to halt at a station to take on fuel and water, Andrews told the agent that they were carrying powder in a special train to General Beauregard's headquarters at Corinth. Then, after another dash, they arrived at a station called Etowah and saw a locomotive belonging to a coal company standing with steam up on a side-track.

The Union engineer who was running the captured train wanted to stop and put the locomotive on the siding out of commission, so that the enemy could make no use of it for pursuit. Andrews, however, opposed making a halt, so they ran on north through Georgia.

At Kingston, thirty miles from Big Shanty, the

train pulled up. The station agent said that a freight from Chattanooga was due soon, and the Union engineer ran his cars over on a siding to wait for the southbound train. The wait seemed very long to the impatient party, but after some time the freight steamed in; from the caboose flew a flag to indicate that another southbound train was behind.

Andrews went over to the man in charge of the freight and declared that he must have the use of the tracks for General Beauregard's powder-cars. The freight's conductor answered that Union troops had captured Huntsville, thirty miles from Chattanooga, and that a number of trains were being run from the city to get stores out of the Yankee's way. That information spurred Andrews to complete his work by burning bridges on the railroad; but he had to curb his impatience: the second freight arrived, it also carried a flag indicating a following train, the track north from Kingston appeared to be very busy.

Meantime train-hands and idlers chatted with the Union men on the captured locomotive and the others of the Union party hid behind the closed doors of the baggage-cars. For over an hour they were obliged to tarry at Kingston; then the freight that was holding them up rumbled by and the "General" with its little train was able to steam north.

The engine halted a mile from Kingston; telegraph wires were cut and a rail pried loose from its fastenings. While they were at this work the men heard

the whistle of a locomotive coming from the south. The enemy were after them! The men leaped into the baggage-cars, the engineer opened the throttle, and away went the "General" at its best speed.

Adairsville was the next station; there a passenger and a freight train were waiting and an express was reported as due from Chattanooga. With the pursuers close behind him, Andrews could not wait and gave orders to run at full speed in the hope of reaching the next siding before meeting the southbound express.

The engineer and the fireman piled on wood and the "General" covered nine miles in nine minutes. In the nick of time they arrived at the next northern station; the express was about to start, but its driver heard the "General's" whistle, and backed up to permit the other train to run on to the side track. The engineer of the express, however, appeared suspicious of the "General" and stopped his train so as to close the end of the switch, then refused to move until his questions were answered. Andrews, held up in front and with pursuers in full cry behind, took a bold step. He strode up to the engineer, pointed his revolver at him, and said: "General Beauregard has ordered me to rush this train through and to shoot anyone who tries to delay me."

The engineer, overawed, made way for Andrews' train.

On thundered the "General." Past the next station the engine was halted, the men cut telegraph

wires and tried to pull up a section of track. A locomotive whistled, and they turned to see an engine crowded with Confederate soldiers bearing down on them. The Yankees tugged at the rail but could not tear it free. Bullets began to fly; the men sprang aboard their train and again the "General" was on the wing.

What was the story of the pursuers of the "General"? There were two quick-witted men at the station at Big Shanty, Fuller, the conductor of the captured train, and Murphy, the foreman of the railroad machine shops at Atlanta. There was no engine near at hand in which they could give chase nor any telegraph station. While the soldiers and stranded passengers ran about asking questions these two men raced along the track. The soldiers laughed to see two men on foot pursue a locomotive; however, Fuller and Murphy had not run half-a-mile before they came upon a hand-car standing on a siding. They put this car on the main track, worked the pump-bars, and flew along at a good pace. Near Etowah the hand-car, coming to the first broken rail, jumped from the track and went rolling down an embankment. The two men were considerably bruised, but they got the car back on the rails and pushed ahead, keeping a sharp eye out for any more breaks in the track. When they got to Etowah there was the locomotive of the coal company standing on the siding, the engine that the Yankee engineer had wanted to destroy but which Andrews had preferred to leave

unmolested. Fuller and Murphy took possession of this locomotive, picked up a load of soldiers, and were off to Kingston.

The pursuers knew that there were a number of southbound trains in the vicinity of Kingston and thought to overtake the captured engine there. Andrews, however, had left the station four minutes before the chasing locomotive arrived. On the track at Kingston stood three heavy freights and it would take too long to wait for them to pull out. Fuller and his mates ran to the farthest train, uncoupled the locomotive and one car, took aboard forty soldiers, and resumed the chase.

Beyond Kingston the Yankees had torn up a rail; this the pursuers saw in time to reverse their engine. The break in the track ended pursuit in that locomotive; it was impossible to get it over the gap. The soldiers gave up the chase, but again Fuller and Murphy set out doggedly on foot. Soon they met a southbound train; this they signaled and stopped, then told the crew about the stolen "General." Immediately the locomotive and tender of the train were uncoupled, soldiers among the passengers climbed into the cab, and Fuller and Murphy were in full chase again.

The two locomotives passed through Adairsville and the next station only a few minutes apart, then the Confederates sighted the Yankees hard at work on a rail. If Andrews and his men could get that rail up they would win and be able to proceed to

burn the bridges at their leisure. The rail was obstinate, however; the men did not have the proper implements for their purpose; the iron bar bent, but the spikes held. They worked at it until a hail of bullets sent them to their locomotive and shelter in flight. If they could gain a little lead they might set fire to the Oostinaula Bridge.

To block the track Andrews uncoupled the rear baggage-car and left it on the rails. The Confederates' locomotive bumped into it and pushed it before the cow-catcher to the next station, where it was switched off to a side-track. This slowed the pursuit and Andrews was able to halt to take on fuel and water and cut the telegraph wires so that no message should be sent north to head off his train. The Confederates' engine began to gain again, and the Yankees crowded into their front car and dropped the second baggage-car. Across the track behind they threw railroad ties; and by this gained sufficient leeway to enable them to stock up with more wood and water at the next two stations and to cut more telegraph wires. Twice they halted and attempted to break a rail loose, but each time they were prevented by a fusillade of bullets. A heavy rain was now falling and thwarted their efforts to set fire to the bridges. The pursuers were gaining as mile followed mile.

Andrews tried every method he could think of to halt that enemy locomotive. He saw a spare rail lying near a curve, stopped his engine, and fitted the

rail into the track in a position he thought would wreck the Confederates. Fortune sided with his enemies; their engine came on at top speed, hit the misplaced rail, bounded up and over it, and held its place on the road. The chase was closing now.

The Union men saw one more opportunity of winning the race. A little distance ahead there was a wooden-covered bridge. The soldiers climbed from the last baggage-car to the engine and tender; all the wood that was left was piled in the car, drenched with oil and lighted; the doors were opened and the draught made by the speeding locomotive soon set the car ablaze. The engine sped into the covered bridge and the car was dropped behind where the flames would ignite the bridge-timbers. That was a barrier of fire that should halt pursuit. The "General" had just enough pressure in the boiler to roll on to the next wood-yard.

Into the flaming bridge the Confederates' locomotive plunged headlong; out it came, pushing the blazing baggage-car to the next switch. The hunt was up; there was no time to stock the "General" with fuel. The Yankees stopped their engine, jumped out, reversed the "General" and, seeing it rolling back to collide with the pursuing locomotive, took to their heels across country.

The pursuers, at sight of the backing "General," reversed their own engine and retreated until the captured locomotive, out of fuel, soon came to a stop.

Fuller and Murphy had saved the railroad for the

Confederacy, Chattanooga was still linked with Georgia and the Union troops could not take the city.

It happened that near the place where Andrews and his men were forced to abandon the "General" there was a regimental muster and a number of planters had gathered with horses and bloodhounds. All the Union fugitives were captured. The two who had reached Marietta but had not joined the others at the hotel were also made prisoners and held as spies. Andrews and seven others were hung. Of the rest, eight managed to overpower their guards and get safely away to the Union lines. Six others started off with the eight but were recaptured and held until they were exchanged in 1863.

Such is the story of one of the most daring railroad adventures in history.

10

THE TRANSCONTINENTAL ROAD OF CANADA

THERE was a splendid audacity in the proposal to build a railroad from the Atlantic to the Pacific across the vast tract of Canada. On the eastern seaboard—when the project was first broached—there were less than five million people settled in a narrow fringe along the boundary between Canada and the United States; on the western coast there were some four or five thousand colonists; to connect these two regions would involve the laying of tracks for a distance of three thousand miles through a wilderness country, much of which had not been explored. Yet the people of British Columbia, on the Pacific side of the continent, made such a railroad a condition of their entering the Confederation of Canadian States.

The question of building this railroad became a political issue; the Conservatives wanted to construct it, the Liberals opposed it on the ground of its great expense. While the parties fought over the

subject surveyors commenced work; Sandford Fleming, a Scotch engineer, set out from Montreal in July, 1872, and arrived in Victoria ninety days later, having made a study of possible routes through the 3300 miles of wild territory he had traversed. In this country there were few warlike Indians to be contended with,—indeed Indians frequently served as guides and assistants to the first surveyors,—but there were plenty of other perils, forest fires, hazards in canoes, the risk of losing the way and starving in the wilderness. Snow storms added to the difficulties and more than one party disappeared in a blizzard and never got back to camp.

For six years surveyors sought the best route, experiencing the chief difficulties in the Rocky, Selkirk, Gold, and Cascade Mountains on the west and in the Laurentian ranges bordering Lake Superior. The task to be accomplished—as was ultimately determined—was to build 2500 miles of new railroad. Of this line 650 miles must be constructed through a country peculiarly unsuited to the laying of tracks, the stretch between the Ottawa River and Port Arthur, on Lake Superior. The section from Lake Superior to Winnipeg, on the Red River, also presented many difficult engineering problems. From Winnipeg to the Rocky Mountains rolled 900 miles of what was known as the Prairie country, although but little of it was level ground; through the Rockies to the Pacific was perhaps the most difficult section of the whole road.

While the surveys were going forward one political administration after another considered the problem of how to construct the railroad. One party in power advocated the policy of building short stretches to unite lakes and navigable rivers. This was not popular, and the government that backed this plan presently gave way to that headed by Sir John Macdonald, whose policy was to go ahead with an actual transcontinental line.

This government accepted the offer of a syndicate to build what was called the Canadian Pacific Railway. Among those who composed the syndicate were George Stephen, the president of the Bank of Montreal, Duncan MacIntyre, the head of the Intercolonial Railway, already built, James J. Hill, the builder of the Great Northern in the United States, and another very remarkable railroad man, Donald Smith, who, having started out in the employ of the Hudson Bay Company in Labrador at a salary of one hundred dollars a year, was now governor of the Hudson Bay Company and who was later to be created for his many achievements Lord Strathcona and Mount Royal.

This syndicate engaged itself, by a contract with the Canadian government signed October 20, 1880, to have a railway in operation from Montreal to Vancouver within ten years, for which it was to receive $25,000,000 in cash, 25,000,000 acres of land, and 712 miles of railroad that were in course of completion. To fulfil their agreement the Canadian Pacific must

lay over 400 miles of track each year, and therefore work was begun simultaneously at several points, from Lake Superior, Ottawa and Winnipeg westward and from the Pacific coast eastward.

From May to December 1881 the company built 165 miles, too short a distance to satisfy the syndicate. The next year a contract was made with the firm of Langdon & Shepard, of St. Paul, Minnesota, to construct the section of 670 miles from Flat Creek, which is 175 miles west of Winnipeg, to Calgary. These contractors advertised for 3000 men and 2000 teams, divided the work among sixty sub-contractors, and as soon as spring opened launched their army of railroad-builders on the northern prairies.

As soon as a sub-contractor completed one section he moved his workmen forward 100 to 150 miles to their next location and in another six weeks the track-layers usually heard the locomotives puffing close behind. Ahead went two bridge-building gangs, who were continually supplied with timber by teams that had to haul it from Rat Portage, 140 miles east of Winnipeg. Each day from twenty to twenty-five 20-ton cars of rails and fastenings and from forty to fifty cars of ties were put in position, and most of this material had been carried an average of 1000 miles before it reached the working gangs.

Heavy floods in the Red River valley so delayed the arrival of supplies that only seventy miles of rails were laid by the end of June. To make up for this, when conditions improved, the work was ac-

celerated, the line advancing nearly two miles a day, and by the end of the year 349 miles were completed and 110 miles of grading accomplished in advance of the rails.

In the first three years of construction 962 miles of main line and 66 miles of siding were laid. Three and one-half miles of track were built daily for several weeks in 1883, and the record day was July 28, 1883, when six and one-third miles were completed. To do that required the laying of 2,120 rails, weighing 604 tons. Twelve men unloaded the rails, twelve placed them on dump cars, and ten, five to a side, put them in position on the road. Following these came two distributors of angle-bars and bolts, fifteen bolters, and thirty-two spikers. Sixteen thousand ties were unloaded; eight men distributed these on the grade, four others spaced them, two more spaced the joint ties, and another pair adjusted the misplaced ties immediately ahead of the front spikers.

To feed this army of workers scattered over 150 miles of country was no small task. The men required two carloads of provisions each day, the horses 1600 bushels of oats daily. The food provided was of the very best. In contrast to the rowdyism, shooting, gambling, and drinking that were so prevalent among many of the construction gangs on the western railroads of the United States the camps of the Canadian Pacific builders were models of law and order. There was an efficient police force, and no intoxicating liquors were allowed in camp. All trains

were searched for contraband goods, and if any man was detected smuggling in liquor he was fined fifty dollars and the liquor was destroyed. For a second offence the fine was two hundred dollars; for a third the fine was four hundred dollars and the smuggler was lodged in a fort with a ball and chain on his leg. There were no saloons, no dance houses, and none of the roughs and professional gamblers who had trailed after the workgangs of the Union Pacific and fleeced the builders of their wages.

While this splendid army was laying the track from Flat Creek to the Rockies the rails were progressing in other sections. In British Columbia 7000 Chinese laborers were forcing a passage through the Cascade Range. Along the northern shore of Lake Superior the going was extremely difficult; 2,500,000 cubic yards of the hardest rock, syenite and trap, had to be blasted by dynamite. Here 12,000 men and 2,000 teams were employed for three years. The severe cold of the winters and the wildness of the country, which was practically inaccessible by ordinary roads, made the work of supply extraordinarily complicated. To store up food for the seven months of winter, when regular communication was impracticable, twelve steamers were constantly employed while navigation was open. Wagon roads could not be built from the northern shore of Lake Superior to the railroad camps: supplies went by a seven-mile portage road to a small lake, six and one-half miles in length, over which they were carried in a steam-

boat constructed on the lake; then they were loaded on wagons and hauled sixteen miles to a second lake, eleven miles long. This lake was navigated by a steamboat; then came a road of two and one-half miles to a third lake and another steamboat, like the others built in the wilderness; this steamer, voyaging twenty-six miles, deposited the provisions at a place from which they could be distributed to the various railroad camps. Six transfers from boat to wagon and wagon to boat, all of them laborious, were necessary to get the supplies in. In winter three hundred dog teams were employed.

On this section of the road five tunnels were driven and ten streams diverted from their courses through rock tunnels; in one place a shelf twenty feet wide and eleven miles long had to be blasted through the rock. Ninety miles of the road cost two million dollars, but the engineering was so well done that the maximum grade was fifty-two feet to the mile and there was no curve greater than six degrees.

In April, 1885, Louis Riel headed a band of malcontents in a rebellion against the government, and thanks to this stretch of track, over which Canadian soldiers were hauled in construction trains, the Dominion forces were able to surprise the rebels and quickly quell the revolt. When they returned in the autumn the soldiers found trains with sleeping and dining cars running on a regular schedule along this part of the line.

The summit of the Rockies had been reached by the end of 1884; here the engineers studied the merits of several possible routes to the valley of the Columbia River. The Howse Pass offered easy gradients, but would add thirty miles to the line. The Kicking Horse Pass, on the other hand, was short but steep. In order to complete the road without loss of time the engineers chose the latter route. In the sixty-two miles from the summit of the Rockies to the valley of the Columbia River the Kicking Horse River falls 2778 feet. This river had to be crossed by the railroad nine times and an immense amount of rock excavated. The drilling, on account of the impossibility of getting machinery over such a trail, had to be done by hand. In one part of the work treacherous landslips caused far more trouble than the rock-blasting.

By the spring of 1885 a gap of only 220 miles remained in Columbia; but across this gap rose the Selkirks and the Gold Range. Here more tunnels had to be bored and gigantic trestles thrown across ravines; from two sides engineers and track-layers worked and finally met in Eagle Pass, in the Gold Range.

Many unusual difficulties were encountered in building this great railroad. At one place, some two hundred miles east of Winnipeg, the line was constructed over the Barclay muskeg, the Indian name for bog. The bog was dense enough to support the

track, but whenever a train ran out on the rails the surface of the bog would undulate and the waves would cause the rails to move from their proper position. This motion sometimes sheared off the track bolts and watchmen had to be stationed at the Barclay muskeg to repair the shifting rails until the engineers worked out a method to hold the track in place.

On the western side of the Rockies the builders planned to drive a tunnel through a spur of the mountains, but the tunnel was no sooner finished than it was filled up with quicksand. Various devices were tried to go through this quicksand mountain, but the tunnel could not be kept clear, and the railroad had to go around the spur.

Two hundred miles east of Vancouver, on the Thompson River, irrigation had caused great landslides; in one instance a huge mass of earth had slid into the river and been stopped by a mountain wall, so that the river was dammed to a height of one hundred and sixty feet and formed a lake twelve miles in length. When the river rose to the top of the dam it flowed over and flooded the neighboring country. Here the railroad engineers could not make the tracks stay where they placed them, the surface of the ground slid; one morning it was discovered that during the night the rails had moved eight feet towards the river and had sunk four feet below grade. To overcome this shifting various experiments were

tried before the builders succeeded in constructing a stationary track.

One of the greatest difficulties was due to the very heavy snowfalls, which frequently sent avalanches crashing down mountain slopes. These slides, moving with tremendous velocity, would cause flurries, or cyclones, which would uproot and batter and blow everything from their path. To protect the line from these great slides miles of snow-sheds were built, and built so skillfully that the Canadian Pacific has had less trouble with snow blockades than railroads in the country farther south.

On November 1, 1885, a train pulled out from Montreal with officials of the company to celebrate the completion of the through line. There was yet one rail to be put in place when the train arrived in the forest at Craigellachie, 2,553 miles from Montreal and 351 miles from Vancouver. No speech-making was indulged in; on November 7, 1885, Donald Smith hammered a plain iron spike in the last rail, and the eastern and western portions of the road were united. Then the dozen or so railroad officials took a holiday and went fishing.

In about four and a half years the Canadian Pacific had laid 2200 miles of rails through a wilderness country that presented many unique problems to its engineers. Montreal was linked westward with Vancouver on the Pacific, and from Montreal the St. Lawrence River carried traffic east to the At-

lantic. As the St. Lawrence is open for shipping only part of the year the Canadian government built a line to connect Montreal with the ports of St. John in New Brunswick and Halifax in Nova Scotia, and thus supplied an all-rail route from ocean to ocean.

11

TRAVEL IN CANADA

THE railroad has made Canada. Without the locomotive that vast area, incalculably rich in natural resources, stretching from the St. Lawrence, the Great Lakes and the Rocky Mountains north to the Arctic Ocean, would remain largely unsettled, unproductive, inaccessible to the world. Journey across it on the map by railroad. Two daily trains—the "Ocean Limited" and the "Maritime Express"—carry passengers over the Intercolonial Railway from Halifax to Montreal. From Montreal to Ottawa we are in the populous country of the French-Canadian; beyond Ottawa the farms are more extensive until the train reaches the great forests along Lake Superior. At Sudbury, half-way between Montreal and Fort William, on Lake Superior, long strings of cars are seen, loaded with copper and nickel, for transport east. One of the richest known deposits of nickel in the world is in this ter-

ritory, and Sudbury is connected with the railroad systems of the United States by a line running to Sault Ste. Marie.

Trains moving east are laden with cattle, grain and flour. From the Lake Superior country vast quantities of lumber are shipped to the Atlantic. Pioneers are making clearings and building villages in this region that was almost impenetrable before the railroad engineers blazed the way. Many tunnels, deep rock-cuttings, long bridges, high viaducts, all bear witness to the gigantic task of making a railroad north of Lake Superior.

Fort William, on Thunder Bay, is the lake terminus of the western section of the Canadian Pacific. On the shore are huge grain elevators, each capable of holding almost two million bushels. Some grain goes east by the railroad, some by boats through the Great Lakes; there is direct water communication from Fort William to Montreal.

More forests, more pioneer stations, with pulp-mills, saw-mills, flour-mills in the vicinity of the Lake-of-the-Woods, which has been made an enormous mill-pond, with an area of 3000 square miles. Four hundred miles west there is a settlement where in 1871 the Hudson Bay Company had a small fort on the Red River at its junction with the Assiniboine. The site of that fort is now the city of Winnipeg, the commercial metropolis of the Canadian Northwest. Here is the great depot that supplies the west from the markets of the east in exchange for western pro-

duce, here from the far north come the traders in furs. Manitoba, the province in which Winnipeg is situated, is one of the world's richest fur-bearing lands.

West from Winnipeg the railroad runs for 1000 miles through Manitoba, Saskatchewan and Alberta to the Rocky Mountains. The Canadian government has surveyed these great provinces and, to provide for the inrush of settlers, has divided them like the squares on a chessboard. Each square is six miles on a side; this constitutes a "township." Each township is divided into thirty-six smaller squares, which are called "sections," and each of these sections is itself divided into four squares. A road allowance, one chain in width, is provided between each of the sections running north and south, and between the alternate sections east and west. The sections are numbered and the odd numbers belong to the Canadian Pacific Railway and the even numbers to the government and the Hudson Bay Company. Two sections in each township are reserved for schools. The lands belonging to the government have been opened for free occupation to properly qualified settlers, each being granted 160 acres.

A plain—a wonderful meadowland for cattle—stretches north and south from the rails as far as the horizon when the train leaves Winnipeg. From Portage la Prairie a branch railroad runs northwest to Prince Albert in Saskatchewan. The next junction is Brandon, situated on the eastern rim of the

steppes that rise to the Rockies. This is the land of the buffalo; here also the soil is very rich and produces splendid wheat, oats, barley, rye, flax, and potatoes.

Regina, the headquarters of the Northwest Mounted Police, 360 miles west of Winnipeg, is a thriving market centre, with railroads running north and south. Moose Jaw is another railroad junction; west of that is Medicine Hat, where the line forks in two routes to Vancouver. The more northerly road, which was the route of the original through line, goes by way of Calgary and Revelstoke; the other by Macleod, a ranching centre, and Kootenay in the gold country.

At Calgary the Rocky Mountains come into view and the train climbs upward through scenery unmatched for natural splendor. The government has established a national park near Banff, the point of departure for tourists who wish to explore the Switzerland of Canada. A few miles west of Banff the tracks reach their highest point, a mile above sea-level. From here the road traverses the Kicking Horse Canyon, crossing from ledge to ledge, twisting and turning, cliffs overhead, a roaring river below.

A broad valley leads across to the ascent of the Selkirks, covered with thick forests. By many curves the road descends again and rises over the Gold Range. Beyond this range is a plain, then the last mountains, the Cascades, are surmounted, and the

train runs to the beautiful harbor of Vancouver on the Pacific coast.

The Canadian government has been a great railroad builder. The pioneer route of the Canadian Pacific has been supplemented by the Canadian National Railway, builder of what is called the "All-Red Route" across the continent. East and west in the Dominion run the tracks of this government enterprise. In the east they link more securely the Maritime Provinces with the Province of Quebec. From the Great Lakes and Winnipeg the western division thrusts across the prairies to Saskatoon and Edmonton, crosses the Rockies through the Yellowhead Pass, follows the Fraser River to Prince George, thence swings northwest to the Skeena River,—the "River of the Clouds," as the Indians call it,—and skirts this stream for nearly 190 miles to its Pacific terminus at Prince Rupert.

Meantime two other railroad systems, the Grand Trunk Pacific and the Canadian Northern, were banding outlying points. Presently the Dominion found itself served by three transcontinental roads, competing for traffic. A commission was appointed to study the problem of competition, with the result that the government took over the Canadian Northern, the Grand Trunk Pacific and its parent road, the Grand Trunk, consolidated them with the Intercolonial and the National Transcontinental, and so formed one great system, the Canadian National Railways.

To serve the "All-Red Route" it was proposed to bridge the St. Lawrence River near Quebec. This was a titanic project. The point of crossing was some eight miles above the city, where the water sweeps between bluffs 200 feet high at a rate of seven miles an hour. The plan called for a bridge of the cantilever type, 3,239 feet in length, with two anchor arms, two cantilever arms, and a central suspended span of 675 feet, making a great channel span of 1,800 feet, or 90 feet more than that of the famous Fourth Bridge of the London and North Eastern Railway.

For six years work on the bridge proceeded, until the south anchor arm and almost one-half of its main cantilever span had been built from the south pier; then, on August 29, 1907, while work was in progress, the lower chords in the anchor arms buckled up. The entire 17,000 tons of steel collapsed, and only eleven of the eighty-six men at work were rescued from the ruin.

This catastrophe led to a new consideration of the whole subject of bridge-building on so vast a scale. Many designs were studied and a new plan tried. Again a span fell into the river, with more casualties. Indomitably the engineers persisted, the mighty arch crossed the St. Lawrence, and on October 17, 1917, the first train ran from shore to shore. The Quebec Bridge is the longest and largest bridge of its kind in the world, a structure of great symmetry and beauty, a magnificent link in the transcontinental chain of the Canadian National Railways.

12

STRANGE EXPERIENCES

THE builders of the western railroads in the United States had many adventures with the Indians and travellers over the completed lines not infrequently saw redmen making hostile demonstration against the locomotives that crossed the buffalo country and made it increasingly difficult for the hunters to bring in meat. The Central Pacific, invading the territory of the Paiutes and Shoshones, had fewer conflicts with the Indians than the Union Pacific, which built in the lands of the more warlike Sioux and Cheyennes. The Central made treaties with the redmen. As Collis P. Huntington, the Vice-President, put it: "We gave the old chief a pass, good on passenger cars, and we told our men to let the common Indians ride on the freight cars whenever they saw fit." The Paiutes and Shoshones enjoyed these novel experiences and helped instead of hindering the running of the trains.

The Apaches of the southwest, although hostile to

the surveyors and graders, made terms with the Southern Pacific when the road was built. It was the Indians of the plains, Sioux and Cheyennes, that took to the war-path against the locomotive.

The Union Pacific in Nebraska and Wyoming was built inside picket lines. "Every mile had to be run within range of the musket," said Chief Engineer Dodge. "In making the surveys numbers of our men, some of them the ablest and most promising, were killed; and during the construction our stock was run off by the hundred, I might say by the thousand; our cars and ranches burned. Graders and track-layers, tie-men and station-builders, had to sleep under guard, and have gone to their work with their picks and shovels and their mechanical tools in one hand and the rifle in the other, and they often had to drop one and use the other."

In 1867 the Indians of the northern plains banded together against the railroad. In the spring the Sioux attacked a surveying party near where the city of Cheyenne now stands, killed the leader, and drove off the others. On July twenty-third a band of three hundred Sioux swooped down upon another party working across the Red Desert, wounded the engineer in charge and stampeded the horses; the surveyors were barely able to escape to the neighboring station of the Overland Stage.

The following month Cheyennes made a sortie against the tracks near Plum Creek, some 230 miles from Omaha. The road was unguarded, and the In-

dians, making use of a telegraph wire, fastened a wooden tie to the rails. William Thompson, head lineman, with a repair gang of five, was sent from Plum Creek on a hand-car to see what had caused the telegraph break.

The Indians, wondering what would happen on the impeded track, sat around a campfire. The repair crew saw the fire, then saw the Indians, then jumped from the hand-car. The car struck the tie on the rails and was catapulted down a ravine. The white men went sprawling in every direction; one of the Cheyennes caught Thompson, shot him through the arm and tore off his scalp.

The Indians were delighted with their little experiment and now pried up a pair of rails, bent them, and piled more ties across the track. Presently a freight train came along, running at twenty-five miles an hour. The engine hit the barricade and leaped from the track, pulling with it the tender and five cars. Two of these cars were thrown clear over the locomotive, the others piled up on the engine and at once caught fire.

The Indians yelled with satisfaction and shot at any of the trainmen who crawled out from the debris, directing their attention to the wreck in front rather than to the caboose. William Kinney, the conductor of the train, and two others, were able to slip from the caboose unnoticed in the darkness. Another freight train was due from Plum Creek and must be flagged before it struck the wreck.

Charles Ratcliffe, a trainman, was hiding under the caboose when he saw an Indian approaching and, jumping up, dashed for safety. In front he saw the headlight of the second freight, a mile away. Over his shoulder he caught a glimpse of two Indians in pursuit. The conductor and his two companions were almost up with the approaching locomotive. Ratcliffe heard the engine whistle, signalling for the brakes. Would the train back away and leave him? The Indians were on his heels. He shouted. The engineer heard him and waited. The Indians were daunted by the headlight, and Ratcliffe reached the locomotive and was pulled aboard. Back to Plum Creek steamed the second freight.

Word was telegraphed to Omaha. The people at Plum Creek, fearing an Indian raid, piled into the freight train to seek refuge at Elm Creek, eighteen miles to the east. Meantime the Indians plundered the wrecked train, set fire to all the cars, and danced around the blaze.

Thompson, the scalped lineman, managed to get to safety at the station of Willow Island to the west. The people of Plum Creek returned in the morning. By nightfall the Indians were riding away, with plenty of loot and a number of scalps.

The next year the Sioux wrecked a train between Alkali and Ogalalla in Nebraska, but the trainmen and passengers were able to stand the Indians off until a relief train arrived. In several instances Indians, planning an attack on the rails, were fright-

ened away by the rush of the locomotive, running at full speed. Stations were surrounded, however, and horses and mules driven off; and for a considerable time passengers on the Union Pacific, as well as the traincrews, went armed against surprise sorties of the Indians of the plains.

Locomotives have met with many strange adventures in the prairie and mountain country. Prairie and forest fires have swept across the tracks with the roar of a tornado. Trains have succeeded in running the gauntlet with full steam on and wetted roofs, but engineers are chary of plunging into such barriers of flame.

At Kiowa, Kansas, in 1878 a locomotive was swept from a railroad embankment by a water-spout and lost in a quicksand. In 1880 a thunder-storm and water-spout passed over the town of Monotony on the Kansas Pacific Railroad, washed away more than 6000 feet of track and covered the prairie with eight feet of water. An entire freight train vanished, being presumably engulfed in a land-slip. Snow has frequently blocked traffic on the western roads. In December, 1872, several Union Pacific trains, with 350 passengers, were snow-bound for two weeks between Percy and Cheyenne. Railroad officials were able to get food to the stranded cars, and the passengers made their way to a small station where they entertained themselves dancing in the back room of a grocery store to the music of a guitar, a mouth harmonicon and a fine-tooth comb.

Through All Weathers the Modern Express Maintains Its Schedule

In the winter of 1880 a train that had left Penn's Grove on the Delaware River Railroad bound for Woodbury, New Jersey, ran into snow-drifts which were said to be as high as the locomotive's smoke-stack. The engineer tried to push ahead, but his supply of coal ran low. The conductor telegraphed word of his dilemma to the president of the road, who sent back reply: "Use all the fence-rails you can lay your hands on, if your coal gives out. Throw in a barn or two, if necessary. If that fails, take all the pork offered at six dollars per hundred. Keep your steam up, and come through at any cost." These orders were obeyed, and the train got to Woodbury late that night. As the road had been ploughed open it was decided to try to keep it so, and the train started back at midnight. Two hours later it stuck in a drift. The telegraph wires were down, and the conductor sent a messenger with a request for another engine. The second engine was sent out, but it also was stalled in the snow. Train and relief-engine were lost sight of for many hours, and were finally discovered by sleighs that hunted for them through the great drifts.

13

UNIQUE ACHIEVEMENTS

§ I

THE ROAD ACROSS THE KEYS

EVERY important railroad has tackled great engineering problems in constructing its lines. The western roads of the United States had to overcome waterless deserts and mountain fastnesses; in the east the difficulties were of a different nature, but they taxed ingenuity and skill. The pioneer American railroad, the Baltimore and Ohio, fought through all sorts of obstacles before it established its through rail route from Chesapeake Bay to the commerce-carrying Ohio River. The Erie Railroad built bit by bit from New York northward and westward to Lake Erie and thence to Cleveland. The Pennsylvania crossed from Philadelphia to Pittsburgh over the Alleghanies and was in a position to render important service to the government during the Civil War. The New York Central, tak-

ing over one small road after another, weaved an amazing net of rails over the populous territory between Manhattan Island and the Great Lakes.

Each of these great systems made important contributions to the history of railroad construction. They, and many other lines, have unique achievements to their credit. Look across the country: there is the Hoosac Tunnel through the Berkshire hills that took twenty-four years to build. It runs straight from end to end for approximately five miles, and is the longest railroad tunnel in the United States. There is the Horseshoe Curve in Pennsylvania; when a freight train is rounding this with a locomotive at the front and the rear the two engines seem to be running side by side, though separated a mile across the gap, and are apparently moving in opposite directions. There is the Lucin Cut-off, where the trains of the Southern Pacific cross Great Salt Lake, a body of water that long defied railroad builders.

Among so many remarkable achievements there are several of particular interest. One of these is the railroad that was built over or through the water.

From the southeast corner of the peninsula of Florida a chain of small islands stretch in a southwesterly curve towards Cuba. These islands, most of them coral reefs, are known as the Florida Keys. The most southerly is Key West, which became an important naval base during the Spanish-American War of 1898. The distance from Key West to Havana, in Cuba, is about ninety miles. To Key West

a railroad has been built from the Florida mainland.

The water between the Keys is comparatively shallow and is bridged by tracks that stretch from reef to reef across the 130 miles from Miami to Key West. The road is actually built over the sea, and at many places the passenger, looking through the car-window, sees only the Atlantic Ocean and the Gulf of Mexico.

Henry M. Flagler, a railroad and hotel magnate, originated the enterprise. The work was begun in 1905 as the Florida East Coast Railway Extension. The builders met with many difficulties. It was no easy task for the surveyors to make a path through the Everglades, the well-nigh impassable swamps and wilderness that cover the southern part of Florida. The business of surveying among the Keys was hardly less difficult, as much of the work of making observations had to be done from boats and often the air was polluted with the exhalations of mangrove forests and filled with swarms of mosquitoes. Some of the Keys were so low and so widely separated from each other that the surveyors had to build towers on the reefs in order to raise their theodolites high enough to view land across the water.

From Miami the railroad was constructed for thirty miles along the edge of the Everglades to the first of the Keys. In making this section giant dredges were used to excavate two parallel canals and pile the mud in an embankment between them, which formed the roadbed for the rails. When the builders

came to the Keys they had to blast the coral and limestone of the little islands. The shorter spaces between the reefs and the lagoons were spanned by mud embankments constructed with the aid of shallow-draught dredges; the longer stretches across the water necessitated trestle-work and arched viaducts of considerable length, made of reinforced concrete and bordered by walls to protect the trains from the battering of wind and water when hurricanes sweep over the Gulf.

One of the stretches is two miles, another four miles, and the leap from Knight's Key to Bahia Hondo is seven miles. This seven-mile space was crossed partly by a viaduct of 120 arches, each supported by twenty-eight piles, capped with a nine-foot layer of concrete. To build this one link there were required 300,000 barrels of cement, 200,000 cubic yards of rock, 3,000,000 feet of timber, and 7,000 tons of steel reinforcing rods; and all this material, as well as the rest used in constructing the road, had to be brought from the mainland on board ships. The transportation of these supplies necessitated the use of a large fleet of good-sized vessels and hundreds of flat-bottomed boats to carry the building material through the shallow water to the islands. Moreover there was the problem of feeding several thousand workmen so far removed from any base where provisions could be obtained in large quantities.

The railroad was constructed to Key West, and practically its whole length is made of embankments

and viaducts. It crosses thirty miles of swamps and lagoons, and thirty miles of open sea; and so well was it built that it has withstood the fury of all the storms that have beat against it.

§ II

THE WEB OF RAILS AROUND MANHATTAN ISLAND

Until a comparatively recent date there were no railways through New York City. That great metropolis, with its wonderful harbor, was the terminus for many roads, but through traffic between New England and the South had to make a detour around the city in order to obtain uninterrupted railroad transit.

For many years the railroads coming to New York from the west had their actual railroad terminals on the New Jersey side of the Hudson River and transported passengers and freight to the city by boat. Then the Pennsylvania Railroad constructed a tunnel from New Jersey under the Hudson to New York City and on beneath the city and beneath the East River to Long Island, one of the greatest railroad tunnels in the world. In the city the Pennsylvania built a splendid station for its traffic from the west and from Long Island.

Within the city boundaries there were then the stations of two trunk railroads, that of the Pennsylvania and that of the New York Central, which was

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HAVANA SPECIAL CROSSING THE FLORIDA KEYS

CANADIAN NATIONAL RAILWAYS BRIDGE OVER THE ST. LAWRENCE AT QUEBEC

Courtesy of Canadian National Railways

shared by the New York, New Haven and Hartford Railroad. The Pennsylvania had a station for through traffic in two directions, the Grand Central Station was an ordinary terminus. Passengers who wished to make a north and south journey by way of the city had still to break their travel at one station and resume it at the other.

The lack of a connecting link for through trains was a great inconvenience, but the cost and difficulty of joining the two routes was felt to be prohibitive. In 1910, however, the project was taken in hand; the requisite funds were secured and the engineers set to work. The most formidable obstacle was the bridging of the East River; the best crossing was at what is known as Hell Gate. The engineers must span this gap without hindrance to shipping.

To preserve the proper grade a considerable section of the road was constructed upon arches. Massive walls of concrete were run up, with openings at the base for the streets of the city. The space between the walls was filled in to the level and the roadbed made on top of this embankment.

The first bridge was built over Bronx Kills, a narrow stream that separates Randall's Island from the mainland and forms the connection between the Harlem and the East Rivers. This bridge was constructed with two lifting spans, hinged on a pier in the middle of the stream, where the caissons had to be sunk to a depth of 90 feet below mean low water. These spans —each 175 feet long—could be lifted to an almost

vertical position and so occasioned no obstacle to shipping passing underneath.

From this bridge the railroad was carried over a viaduct, the arches of which rose gradually until they attained a considerable height at the next river, the Little Hell Gate channel. This channel was crossed by a bridge with four spans, each of 300 feet, with two tower piers, and with three arched piers in the stream. The next section of the line was a curve of half a mile over a viaduct of steel girders, which brought the railroad to the east side of Ward Island, at the narrowest point of the East River, the gap called Hell Gate.

Shipping was heavy at this place and the river had to be left clear. To cross from Ward Island to the opposite shore of Long Island was the main problem of the engineers of this road. They accomplished it by building a bridge with a single arch, a span of no less than 1,017 feet, the largest opening ever made in a bridge of this type. A huge tower, 250 feet high, had to be constructed on either bank to support the massive steel fabric that carried four railroad tracks. On account of the strong tides, the velocity of the current, and the rocky bed of the river at Hell Gate the arch was built on the "overhang" principle, that is, it was constructed simultaneously from each tower and the weight of the projecting sections was counterbalanced by temporary steel backstays behind the towers.

The two halves of the arch met on October 1, 1915.

The deck for the railroad tracks, suspended from the giant span, was set in place, together with the footway for pedestrians on either side, outside the arch. From its foothold on Long Island the road was carried forward over another viaduct of arched concrete piers and another filled concrete embankment to the point where it could make connection with the tracks of the New York, New Haven and Hartford Railroad and so secure a through rail route from the lines of the Pennsylvania system to those of New England.

§ III

UP PIKE'S PEAK

Captain Zebulon Montgomery Pike, commanding a party of soldiers, guides and Indians who were exploring the Rocky Mountains in 1807, recorded in his journal on November fifteenth that "at two o'clock in the afternoon I thought I could distinguish a mountain to our right, which appeared like a small blue cloud. . . . In half an hour they appeared in full view before us. When our small party arrived on the hill they with one accord gave three cheers to the Mexican mountains."

The explorers remained in sight of that mountain peak that was like "a small blue cloud" for many days. Pike climbed some of the mountains, but not that particular peak, which was snow-clad, bare of

vegetation, and twice as high as those he ascended. He stated it as his opinion that "no human being could have ascended to its pinnacle."

This mountain—named Pike's Peak in honor of its discoverer—towers up in the Rockies, not far from the present city of Colorado Springs, to a height of 14,147 feet above sea-level, and commands a view of 100 miles over a rugged country that contains many lakes and the headwaters of four great rivers, the Platte, Arkansas, Rio Grande, and Colorado. Rich deposits of gold were found in the neighborhood of its base in 1858 and attracted many miners. The peak long resisted the efforts of climbers; but railroad surveyors and engineers have fought their way up the mountain and have built a track to the top.

The Pike's Peak Railway, which was opened in 1890, is the longest cog-wheel road yet constructed. It starts at Manitou Station, on the Denver and Rio Grande Railroad; Manitou is 6000 feet above the sea; from there the road rises some 8,000 feet to the summit by a track a little less than nine miles long, with an average gradient of 19 feet in 100. The road-bed is solid, and from fifteen to twenty feet wide. At spaces of 200 feet the rails are anchored to substantial masonry in order to prevent any slipping. Each locomotive has three cog and pinion appliances, which can be used together or independently; in each cog there is a double pinion brake and either one of these can stop the locomotive in ten inches, up or

down the incline, and when travelling at the maximum speed allowed on the road. The passenger car, which is always placed on the down-hill end of the engine, is supplied with separate brakes.

From this railroad one has a superb view of the Garden of the Gods and the great plains to the east, and to the west a panorama of the soaring snow-capped mountains that make up the Continental Divide. The train runs along steep precipices and finishes with a straight climb on a gradient of 25 feet in 100 to the topmost point of Pike's Peak.

14

TRAINS AND TRACKS

THERE was little luxury to travel on the pioneer railroads. Trains were often delayed and passengers went hungry. The cars were flimsily built and shook and jolted and creaked over the rude roadbeds. Stoves provided the heat, which was apt to be too much for those travellers near them and too little for those at a distance. The Harlem Railroad was complimented in 1845 for introducing cars "so high that one can stand erect when he cannot find a seat." By 1859 several roads were employing so-called sleeping cars; in most instances these were ordinary coaches with three tiers of bunks, for which the company supplied mattresses and pillows.

George M. Pullman, of Chicago, rode from Buffalo to Westport in one of these sleeping cars in 1859, and the discomforts of the journey led him to consider the possibility of constructing a coach in which passengers could really sleep. The idea interested him so much that a few years later he arranged

with the Chicago and Alton Railroad to build a new type of sleeping car.

This car—named the "Pioneer"—was so constructed that it was a foot wider and two and a half feet higher than any coach then built. A railroad friend of Pullman pointed out that the "Pioneer" could not be used on the tracks, because it was so large that it would not clear the station platforms and bridges.

"I know it," agreed the builder. "I suppose you'll have to cut down the platforms and rebuild the bridges."

Since Pullman would not alter his coach the railroad built a line of track to fit it. The inventor then invited a party of editors and railroad officials to take a trial ride in the "Pioneer." The guests were greatly surprised when they boarded the new coach. Not only was it very large, but it rested on eight-wheeled trucks instead of the customary four-wheeled trucks, had a high deck with ventilating transoms, and was beautifully panelled and decorated. The best passenger cars cost four thousand dollars to build; the "Pioneer" had cost eighteen thousand dollars. The guests examined and admired. Then one of them said: "I thought this was a sleeping car. Where are the passengers supposed to sleep?"

Pullman evaded the question by inviting his guests to have something to eat. Porters fitted little tables between the seats, set out linen, china, and silver, and

served a delicious meal. When the guests had enjoyed this to the full their host asked them to go into a day coach for a few minutes. Soon he called them back. To their amazement the "Pioneer" was transformed. The seats had vanished, and in their stead were luxurious beds, furnished with sheets and blankets, and partly screened by handsome curtains.

The guests tried the beds and found them all that could be desired in the way of comfort. Then they rose and watched the porters change the sleeping car back into a day coach. The demonstration was a complete success. The guests spread the news of the wonderful coach and everyone wanted to ride in it. Yet there were many who, having admired the "Pioneer," declared that the use of such coaches was a commercial impossibility; the beds, the carpets, the upholstery would be spoiled by the rough-and-tumble passengers.

To these objections Pullman answered: "I have always held that people are very greatly influenced by physical surroundings. Take the roughest man, a man whose lines have always brought him into the coarsest and poorest surroundings, and bring him into a room elegantly carpeted and furnished, and the effect on his bearing is pronounced and immediate. I am not at all afraid people will go to bed with their boots on. I am convinced that if I devote all my energies to providing handsome cars the financial returns will take care of themselves."

So, in spite of all criticism, Pullman went on build-

ing and improving his coaches. The second one cost twenty-four thousand dollars. The Michigan Central Railroad altered its stations and bridges and ordered some of the new sleeping coaches. When they were ready for service the question of the proper charge for a berth arose. The charge on the Woodruff sleeping cars that had been used by the Michigan Central was a dollar and a half for the trip between Detroit and Chicago, but that price would be too low to obtain a proper return on a twenty-four-thousand-dollar coach.

Pullman said that he intended to charge two dollars for a berth.

"My dear sir," exclaimed the president of the Michigan Central, "that is not to be thought of. If you undertake to charge two dollars a berth when other roads only charge a dollar and a half between Detroit and Chicago, you will simply drive all the night travel to our competitors. It is no concern of mine that you have chosen to spend so much money for useless luxuries for people who will not appreciate them and do not want them."

"People are willing to pay for the best, if they get the worth of their money," Pullman replied. "Run your cheap cars as usual at a dollar and a half a berth and put my cars on the same train at two dollars a berth, and let the public choose between them."

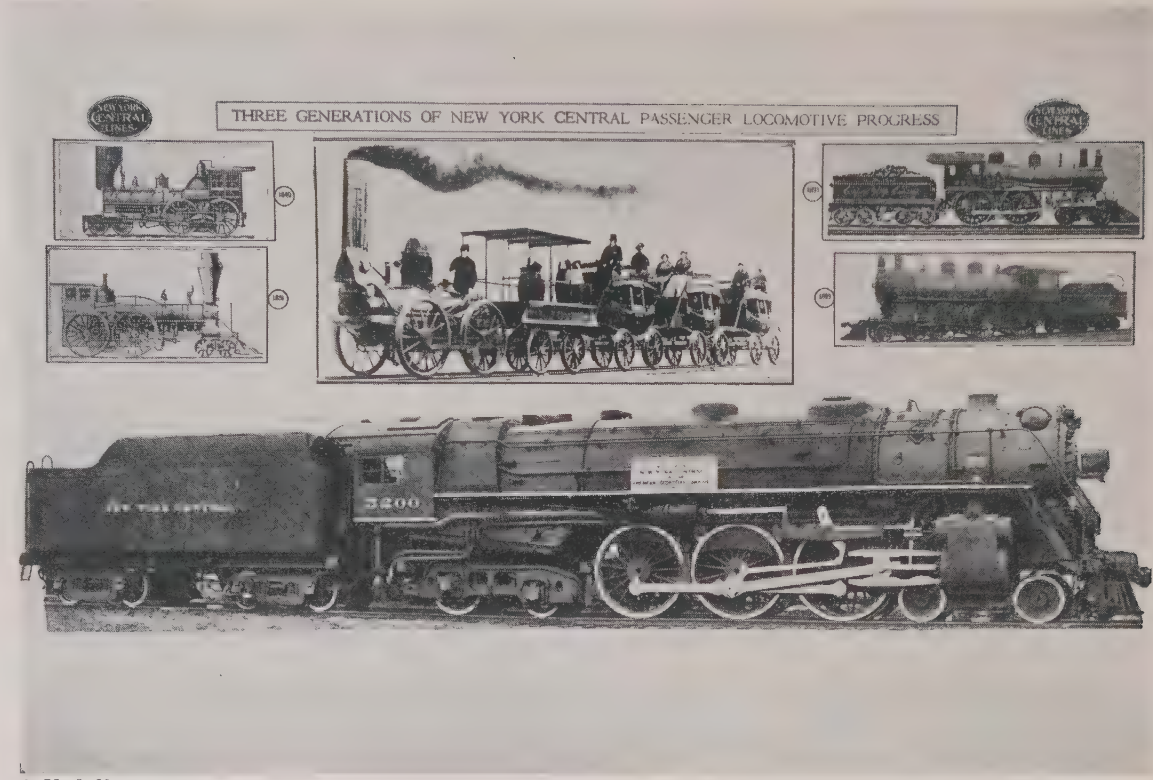
The suggestion was adopted. Passengers refused to purchase the cheap berths so long as any in the

Pullman coaches could be had, and those who could not get berths in the Pullmans complained so vociferously at the discomfort of the old style that within six weeks the cheap cars were discarded and only Pullmans used. Traffic was won from other railroads and as a result competing lines were forced to buy Pullman coaches for their through trains.

When the Union Pacific and the Central Pacific opened their through line between Omaha and San Francisco Pullman cars made part of the transcontinental trains and demonstrated their superiority in comfort and convenience over all other types of coaches.

The Pullman Palace Car Company was originated in 1867 and built sleeping cars for use on the railroads of Canada as well as on those of the United States. A new type of car, the "hotel" sleeping car, was introduced on the Canadian Great Western road; this was a Pullman sleeper with a kitchen at one end, and meals were served at tables between the seats. The first regular dining car, christened the "Delmonico," was employed on the Chicago and Alton Railroad in 1868.

Sir James Allport, the general manager of the Midland Railway of England, on a visit to America was so much impressed with the luxury of the new coaches that he invited Pullman to go to England to explain his innovations, and as a result Pullman dining- and sleeping-cars were adopted on various British roads.



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THREE GENERATIONS OF LOCOMOTIVES

Locomotive of 1840	The De Witt Clinton	Locomotive of 1893
Locomotive of 1851	Locomotive of 1927	Locomotive of 1899

Pullman continued to work on improving train service; one of his ideas was to provide a safe means of passage from one platform to another while a train was in motion. Canvas diaphragms had been used between cars as early as 1857, but had not served the purpose. Pullman devised a better method, and the modern vestibule was patented in 1887. By this means an entire train is made into one whole, and passengers may go as safely from one coach to another as from room to room of a house.

Almost all of the American railroads are of the standard gauge, 4 feet 8½ inches. The first rails were long wooden stringers, on top of which was fastened a thin, narrow piece or strap of iron. These were called strap-rails. The stringers rested on granite blocks, which were set in the soil of the roadbed.

An early improvement was the substitution of wooden cross ties for the blocks of granite, which had jolted engines and cars to pieces. Then Robert L. Stevens designed the metal T-rail, a much better and heavier rail than the wooden stringers with the narrow straps, and most of the American roads replaced the strap-rails with the more satisfactory T-rails. The rails, both in America and Europe, were made of iron.

In 1859 an Englishman, Henry Bessemer, discovered a method of making steel in large quantities and at low cost. Steel rails could carry much heavier loads than iron rails and lasted much longer; they were therefore adopted on railroads. The first steel

rails were used in the United States about 1865 and were found to last fifteen times as long as the iron rails.

What a marvellous story is that of the railroad in North America! In 1830 there were 23 miles of railroad tracks in the United States. By 1850 there were 9,021 miles, most of which was in the territory between the Atlantic Ocean and the Alleghanies, though railroads had reached to Chicago and Detroit. By 1870 the mileage was 52,922; the rails had leaped across the continent to San Francisco. A decade later and the Southern Pacific and Santa Fé have built a second route to the Pacific through the southwest and the Northern Pacific is crossing the Dakotas from St. Paul. The greatest era of railroad building in the United States was between 1880 and 1890, which saw 70,000 miles of new tracks laid. Since that time there has been less building, because most of the necessary lines had by then been constructed; repairs to tracks and rolling-stock took the place of new projects.

The United States has approximately 270,000 miles of railroad. In comparison Europe has approximately 217,000; Asia 69,000; and Africa 29,000.

Separate railroads have been combined in great railroad systems and nine of these control about two-thirds of the total mileage of the country. These systems are, with their mileage in round numbers: The New York, New Haven and Hartford, 7,000; The New York Central, 23,000; The Pennsylvania, 14,-

000; The Southern, 29,000; The Northern Pacific and The Great Northern, 28,000; The Union Pacific, 34,-000; The Chicago, Milwaukee and St. Paul, 10,000; The Atchison, Topeka and Santa Fé, 11,000; The Southern Pacific, 10,000.

Over these great systems run celebrated express trains, the ultimate of luxury in railroad travel. In the east, among many others, are the "Merchants' Limited," the "Bay State" and the "Knickerbocker" between Boston and New York; the "Twentieth Century" of the New York Central from New York to Chicago; the "Broadway" of the Pennsylvania from New York to Chicago and the "Congressional" of the same road from New York to Washington. In the west are the "Sunset Limited" of the Southern Pacific, linking New Orleans, El Paso and San Francisco; the "Katy Limited" of the Missouri, Kansas and Texas Railroad between St. Louis, Houston and Galveston; the Union Pacific's "Golden Gate Special"; the "Panama," the "Overland," the "North Coast," the "Shasta," of other western roads.

Canada has its great through trains, such as the "Continental" and the "National" from Montreal and Toronto respectively to Vancouver. Other expresses join important cities of the two countries, and the network of steel rails has brought the St. Lawrence River and the Gulf of Mexico, the Atlantic and Pacific Oceans within a few days' journey of each other, an achievement that would have been laughed at as a fairy tale a century ago.

PART THREE

SOUTH AMERICA

1

OVER THE ANDES

TRAVEL in South America goes north and south, generally speaking, and the main highways lie along the two oceans. This is due to the circumstances that most of the population dwell at the seaports and that the most fertile territory is adjacent to the coasts. Down the length of the continent stretches the high barrier of the Andes, dividing east and west by a gigantic ridge; east of the great Cordillera, in central South America are vast, impenetrable forests and swamps.

West of the mountains is Chile, lying like a ribbon between the Andes and the Pacific, extending for almost three thousand miles from the Peruvian border to Tierra del Fuega, with an average breadth of not more than ninety miles. This country is thirty times as long as it is wide. In the north are deserts where no rain ever falls, in the south the rocky, storm-swept islands that fringe the Strait of Magellan, to the east mountain peaks towering eight

thousand feet higher than Mont Blanc. Yet the most of Chile is rich in mineral deposits and arable land, and therefore along the ocean is a line of prosperous cities and thriving seaports.

Due to its peculiar topography the railroads of Chile run longitudinally through the valley between the ocean and the Andes, following trails of great antiquity. From Tacna, near the frontier of Peru on the north, rails extend almost continuously to Puerto Montt at the edge of the Gulf of Reloncaví, a distance of some 1500 miles. To connect with this main artery branch lines, averaging from 30 to 50 miles in length, have been built at thirty points running westward to the Pacific.

Three railroads have climbed from Chile across the Andes. One of these extends from the port of Antofagasta to La Paz in Bolivia, 518 miles; another runs from Arica on the northern seaboard—formerly in Peru—to La Paz, 260 miles; the third is the great Transandine line that joins Valparaiso on the Pacific with Buenos Aires in Argentina on the Atlantic Ocean and covers 896 miles.

Railroad building began in Chile in 1852, with the construction of a road between the two important settlements of Valparaiso on the coast and Santiago inland; cities that had formerly only been connected by a primitive cart road. The distance in a straight line was not more than 55 miles, but the mountains near the ocean rose to considerable heights and the track had to be curved; this and other delays, some

of them due to revolutionary uprising, prevented completion of the through Valparaiso-Santiago railroad until 1863.

Previous to this, however, a little line had been built from the Chilean copper mining town of Copiapó to the small port of Caldera; this was opened to traffic in 1852, and was the second oldest railroad in South America, the pioneer road being the Demarara line in British Guiana.

While the Valparaiso-Santiago railroad was being constructed a number of longitudinal roads were in process of building, most of them to serve the mining sections; some of these were organized by English and American companies and employed English and American engineers, who were more accustomed to railroad-building than the native Chileans. These companies were afterwards taken over by the government of Chile and their lengths of track incorporated in the main trunk system that stretched from north to south.

In 1866 two Chileans, Don José Santos Ossa and Don Francisco Puelma, started out to explore the Atacama Desert in search of nitrates and other mineral salts. They crossed the foot-hills of the Andes and came upon the great wind-swept plateau beyond. Here they found what they considered a very promising prospect, and proceeded to secure from the government of Bolivia the right to exploit five square leagues of the desert and to develop four square leagues for agricultural purposes in the San Mateo

Valley, near La Chimba, as the territory around what is now called Antofagasta Bay was then designated. To work this concession the Atacama Desert Exploration Company was formed and the company started to build a highroad, 75 to 90 miles in length, from the seaboard to the nitrate fields.

The company then sought a charter to build a railroad. Meantime valuable minerals were discovered, and so many emigrants pushed over the highroad to the interior that the company, unable to handle the traffic, handed the project over to the Bolivian government. Control of the road was acquired by the Antofagasta and Nitrate Railway Company. Then President Melgarejo of Bolivia, who had granted the original Ossa-Puelma concession, was driven from power and the rights he had granted were annulled by the government in 1872.

After much wrangling a new agreement was reached and work was begun on the railroad, which was to make its seaboard terminal at Antofagasta, 600 miles north of Valparaiso. The tracks had reached as far as Salinas by 1879; then Bolivia and Chile went to war. Chile won and the spoils of victory gave the whole stretch of Bolivia's sea-coast to Chile. As a result the railroad now lay within Chilean territory. Again the road changed hands, and eventually English financiers reorganized it as the Antofagasta (Chile) and Bolivia Railway Company.

With the successful development of this railroad the port of Antofagasta, which had been a small,

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A Railway Train that Crosses the Equator

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On the Roof of the World, Over the Andes Mountains in Peru

straggling settlement, blossomed into a large and prosperous city. It was, however, impossible to acquire the terminal facilities needed there, and so the railroad company built another seaboard terminus at Mejillones, 37 miles to the north; this port, with its splendid land-locked bay providing protection against the southwest gales, was only brought into use in 1906, but has speedily become one of the most important shipping points on the Pacific side of South America.

The Antofagasta and Bolivia is a very interesting railroad. It carries a great volume of traffic, but its gauge from the coast to Uyuni, a distance of 382 miles, is only 2 feet 6 inches, or a little more than half the standard gauge. At Uyuni the gauge is widened to the Bolivian standard of 3 feet 3 3/8 inches. The narrower gauge was adopted by the builders because they thought it would facilitate and lessen the cost of construction through the mountainous country. Fortunately there are no tunnels, except in the section near La Paz, and very few bridges, so that no limit is imposed on the gauge of the rolling-stock of the through road.

This railway travels over one of the highest and most formidable mountain ranges in the world, and some of the country it traverses is almost barren of vegetation, though rich in fertilizing products. The engineers, by the use of sharp curves and steep embankments, were able to avoid gigantic natural obstacles that stood in their way. Their greatest tri-

umph was the bridging of the Loa River by a steel viaduct 800 feet long. Here the rails are carried at a height of 336 feet above the river, which is itself 10,000 feet above the Pacific, the second greatest height of the railroads of the world, and only a few feet lower than the rails of greatest height, those of the Oroya Railroad of South America.

At Antofagasta the track is almost level with the ocean, but 225 miles inland it is some 2½ miles above the Pacific. The route is a steady climb, across the nitrate country and into a waterless region. This lack of water was for long a serious difficulty, but plentiful mountain streams were discovered 40 miles from the railroad and pipe-lines were laid down over the 195 miles to Antofagasta.

The road reaches its summit at Ascotan, 13,000 feet above sea level, and 225 miles from the coast. Thence it slopes to Cebollar and skirts the largest borax deposit in the world. Crossing the frontier, it traverses the great plateau of Bolivia and bending towards the north over this table-land proceeds to La Paz, its inland terminus.

The most interesting railroad of South America is of course the Transandine, which unites the two oceans by surmounting the backbone of the continent. Chile and Argentina are divided from each other for more than two thousand miles by the Andes, which are so high and so impassable at most points by any but trained mountaineers that there has been but lit-

tle commercial communication between the people on the opposite sides of the range. The two countries, extending side by side for such a length, are very different from each other in climate, in natural resources, in the character of their populations, and this difference is due to the great mountain barrier. In the northern part of the continent the eastern side of the Cordillera is abundantly watered by rain, the western slope an arid desert. In the southern section, however, conditions are reversed; there the prevailing winds are from the west and these winds bring rain from the Pacific that water the western or Chilean side of the Andes but do not carry moisture over to the Argentine slopes. Here therefore Chile was fertile and well populated while the corresponding section of Argentina was unproductive and scantily settled.

Few travellers in early days attempted to cross the range, but in the sixteenth century Mendoza, the Spanish governor of Peru, built a town in the Argentine foothills of the Andes where a river descended from the glaciers of Aconcagua, and this settlement, called Mendoza, gradually attracted a considerable population. Passes were discovered through the mountains and there was some going to and fro. The two countries were jealous of each other, however, and each was more interested in building up its seaports and trading with distant lands than in laboring on a mountain road. All the South American nations

looked to the sea as the highway for their commerce and for long turned their backs on the great chain of the Andes.

Mendoza's settlement, close in the eastern foothills, prospered exceedingly, and it was this fact that presently attracted attention to the needs of the interior part of Argentina. Railroads were being constructed across and through the high Alps in Europe, and if the Alps could be bridged by rails, why not the Andes?

Two Anglo-Chilean brothers, Juan and Mateo Clark, both engineers, planned a cross-mountain railroad, and secured a concession from the Argentine government in 1872 and from the Chilean in 1874. The problems of construction were many and funds were scarce, so the labor was divided into four sections and the work on each was done by a separate company. The government of Chile had already built a branch line from its main longitudinal system east from Llai-Llai towards the Andes as far as Los Andes, 2733 feet above sea level. This road followed the old trail towards Juncal and The Uspallata pass by which travellers and mule-trains had crossed to Mendoza and Buenos Aires, and it was this trail that the Chilean Transandine railroad adopted for the greater part of its course from Los Andes to the frontier in the high mountains. This stretch of track, although short in actual distance, presented some of the main difficulties of the entire road and was the last to be finished.

Construction of the road from the frontier to the eastern terminus of Buenos Aires was in charge of three companies: the mountain section from the end of the Chilean line to the town of Mendoza was built by the Argentine Transandine Company; the section from Mendoza to Villa Mercedes by the Argentine Great Western Company; and that from Villa Mercedes to Buenos Aires by a company subsequently called the Buenos Aires and Pacific Company.

The Villa Mercedes–Mendoza section was easy to build and was opened to traffic in 1886. The Buenos Aires–Villa Mercedes link, which crossed the pampas, was ordinary railroad construction, and was completed in 1888. The difficult part was the mountain section west from Mendoza. Farther north, where the Antofagasta line was constructed, the Cordillera forms the western side of a high plateau, but as it continues south to the neighborhood of Mendoza it narrows to a single very high ridge with summits ranging from 18,000 to 23,000 feet above sea level. The Uspallata Pass had been the favorite point at which to cross the Andes, and towards this objective the Argentine builders began to lay their tracks in 1887 up the winding valley from Mendoza to the ridge, while on the other side through a shorter valley the Chilean rails advanced in 1889.

A part of the Argentine line was soon constructed and utilized for traffic. The surmounting of the ridge by rails was more arduous, and the work halted for some time; travellers completed the transandine

journey by crossing the summit on mule back or on foot, as in former times, or in vehicles driven up a steep incline. The old mule road traversed the Cumbre at an altitude of 14,500 feet, and was blocked to all ordinary travel by snow from April to October. The builders of the railroad ultimately solved the problem by driving a tunnel through the top of the Andes and so forming a junction of the Chilean and Argentine lines. This was opened in 1909. This tunnel of the Cumbre is only two and a half miles long, and much shorter than the Alpine tunnels of Mont Cenis, St. Gothard and the Simplon; but its height, 12,000 feet above sea level, is much greater than that of those tunnels and the scenery along this upper section is of wild magnificence.

On the Chilean side of the tunnel the railroad was protected from snow by a rampart of sheds, but even so the line has freqently been blocked by great drifts and avalanches and sometimes traffic has had to be suspended for three or four months.

Yet in spite of interruption due to storms the Transandine railroad has been of great value; Chile has been brought into close communication with the markets of Argentina, Uruguay and Brazil; Buenos Aires by this route has a much shorter road to the Pacific, Australia and India; and the distance between the ports of Europe and Valparaiso has been shortened by over 2000 miles in comparison with the former journey through the Strait of Magellan.

The transcontinental trip may commence at the

seaport of Valparaiso, from which city the railroad runs through hilly, fertile country to the station of Llai Llai, the junction for Santiago. Proceeding eastward, the hills grow higher and through intervales the peaks of the range may be seen. The Transandine railroad proper, the Ferro Carril Transandino, starts from the attractive settlement of Los Andes, and here the passengers change to cars of narrower gauge. The grades on the Chilean side are very steep and the valleys very narrow; the railroad builders found that to bore corkscrew tunnels such as those on the St. Gothard line in Switzerland would be too expensive, and therefore made use of the cog-wheel system wherever the incline was too steep for an ordinary locomotive. On the Chilean section the maximum grade is 8 per cent; on the Argentine, where the rack or cog-wheel system is adopted in some places, the grade does not exceed 6 ½ per cent. Up through a narrow valley the track winds as it ascends towards the peaks.

At one place, called the Soldier's Leap, the train runs along a rock shelf through a gorge above which the crags almost touch, while a torrent roars at the foot of the cliffs. Above the line of vegetation a barrier imposes itself across the valley. On the western side of this ridge is the little village of Juncal, from which the traveller in pre-railroad days used to start on foot or mule-back to climb the pass. Ahead is a primitive mule-track that zigzags up the summit. Turning at right-angles from its former eastward

course, the railroad here heads through a valley to the south, crosses a torrent, shifts to the north and crawls along a narrow shelf. The grade here is very steep; tunnel after tunnel is passed until the train comes out into a wide basin, 2000 feet above Juncal. In the northern end of the hollow is a small lake, the Lago del Inca. This is a barren place, of rock and frozen water, surrounded by majestic peaks.

From the Lago del Inca the railroad makes another sweep, ascends another slope and reaches a still higher basin at the foot of a giant ridge. Here, 10,486 feet above the sea, is the mouth of the great tunnel of the Cumbre, and on the summit of the pass stands the bronze statue of the Christ of the Andes, a figure of more than twice life size posed on a pedestal hewn from the rock, and turned to the north so as to bless both countries with its uplifted right hand.

The tunnel of the Cumbre brings the train into Argentina, where the view is of wider valleys and smoother mountain peaks. The track follows a torrent that has made a course through the rocks and passes the head of a glen down which comes the sweep of the glaciers of Aconcagua, the highest of the peaks of the Western Hemisphere. Presently the valley opens into the plain of Uspallata, from where the road runs to Mendoza, an oasis in an almost waterless tract. This prosperous town lies on the edge of the pampas, and eastward the foothills of the Andes descend in gentle swells to the level country that stretches for six hundred miles to Buenos Aires.

Mendoza boasts many fine vineyards; to the east across Argentina the track runs without a curve or bridge, through desert, then pasture land, then great wheat fields; the climate becomes moister and supplies more grass for ranching and in the region near the Atlantic the rainfall makes possible those great tracts of grain which are the pride and wealth of Argentina.

2

A RAILWAY IN THE AIR

THE longest aerial railway in the world has been constructed in the Republic of Colombia in South America to serve the coffee trade. The town of Manizales is the centre of the district most favorable to the cultivation of the coffee bean. This town is situated in a valley through which the Cauca River flows between two ranges of the northern Andes, but although this river communicates with the Atlantic Ocean it is not serviceable for transportation. The main highway for commerce from the coast to the interior is the Magdalena River, to the east of the Cauca and flowing between the eastern and central mountain ranges.

Transportation was a difficult problem to the coffee-growers. The coffee had to be carried by mules over the central Andes by a trail that wound zigzag up and down steep slopes to Mariquita, and thence to Honda on the Magdalena. At Honda the coffee was transferred to canoes for the voyage of 400 miles to the seaboard. Such method of transport was very ex-

pensive, and the round-trip frequently took from three weeks to a month.

Presently steamboats were introduced on the Magdalena River, a great improvement in the handling of traffic, although the boats could not go as far south as Honda, on account of rapids and difficult reaches of water. Steamboats made the river journey much more expeditiously and cheaply than canoes, and the coffee interests turned their attention to overcoming the obstacles of the trans-mountain part of the route.

A company was organized in London, the La Dorada Railway Company, and built a standard gauge railroad from La Dorada, the terminus of the up-river steamboat traffic on the Magdalena River, along the river to Honda and on to Ambalema, where it joined the tracks of the National Railways of the Republic of Colombia. A branch line was also constructed from Honda to Mariquita, a short way inland, which is actually the river end of the cross-country trail to the Cauca Valley and Manizales. The company wanted to carry their railroad on over the mountains, since such a line connecting Manizales and La Dorada would give a tremendous impetus to the settlement of the rich agricultural land between the ranges. The engineers set to work, but speedily discovered that it was impractical to build a surface railway of less than 187 ½ miles with the requisite grades and curves. Such a road could not be made to pay its way; and the engineers declared that the only commercially practical scheme was to construct an

aerial ropeway that should follow the contour of the mountains.

Ropeways had been built in other countries, but none of such a length as the one proposed here and none that crossed such difficult territory. A German firm of contractors made a survey but were blocked by a great vertical cliff that towered above a ravine. Then an English firm took charge; their engineer, James F. Lindsay, arrived in Mariquita in 1913, set out to study the route proposed by the Germans, and decided to adopt a different road for his ropeway.

Meanwhile the district was seething with discontent. The coffee-planters were delighted with the prospect of securing quick and cheap communication with Mariquita, but the *arieros,* who carried the traffic across the mountains in their ox-trains and mule-trains, considered that the ropeway would put them out of business, with no work for their 10,000 animals. The *arieros* vowed they would destroy the new line as fast as it was built.

Lindsay the engineer argued with them, declared that the ropeway would create a bigger demand for coffee, suggested that they acquire land, plant coffee fields, and use their animals to carry their produce to the stations along the line. At this juncture the Bishop of Tolima arrived at Mariquita, talked with the engineer and with the *arieros,* investigated, and agreed with Mr. Lindsay that the ropeway would benefit all classes in the country. The bishop's appeal

Building the Road Over the Andes 13,000 Feet Above the Pacific

cleared up the dispute, and the *arieros* agreed to help, not hinder, the new project.

The engineer returned to his survey of the mountains, a task that took him through dense forests and up wind-swept, snow-covered peaks. The native guide who went with him lost his way, and the engineer set out a second time accompanied only by his faithful dog. The country was wild and rugged, spurs branched off in all directions from the main ridge, volcanic ash stretched from the base of the mountain El Ruiz, which rose 15,000 feet high. He found a practicable route, however, and in the autumn of 1913 the building of the ropeway started.

The railway was constructed section by section, and as each was completed it was used to move forward the material required for the next section ahead. The line was divided into fifteen sections, and by this method of bringing up material much of the difficulty of hauling supplies over the roads was avoided, which lightened the labor considerably, as the roads in the mountains were either covered with huge boulders or spongy with quagmires. It was no easy task to build that ropeway; in the low altitudes the workmen moved through thick and matted vegetation, on the heights there were tremendous winds; in some places the road was 12,000 feet high; cold and dense fogs and drenching rains added to the difficulties.

One of the tasks was to prevent the mountain-mass

sliding down into the cuts made in the slopes. The engineer had an experience with this at Fresno. He was breakfasting with some of his staff in the outer room of the building where he had his office when a rumbling and then a loud roar was heard. The mountain-side was in motion. Trees and boulders swept past, and then the building began to slide sideways.

The party in the shed gripped their seats and wondered if the building would stop before it reached the edge of the cliff. The shed kept on moving; then it halted and careened over on one side. The engineer and his companions crawled cautiously to the door, managed to get this open, and peered outside. The building had halted a few inches from the cliff and they could look from the door down the steep mountain-side. By a miracle the men were safe.

The towers that carry the cable that makes the ropeway were first built of wood, with a steel tower afterwards constructed within the wooden casing. There were 378 of these towers to support the 45 ¾ miles of ropeway. The cable was of steel; 93 miles of this was used to make the two roads. In the fifteen sections of the line there were eight driving stations; the carrier was switched from section to section by a length of steel runway and then swung on to the rope at the next section station.

At Mariquita the ropeway makes connection with the surface railroad, which allows the direct transhipment of freight. From Mariquita the ropeway runs on a steady ascent to Fresno, a distance of about

16 ¾ miles; thence it descends to Soledad, and then climbs through the main range of the mountains, making a vertical ascent of more than a mile in the course of about ten miles. From the highest point, 12,250 feet, it slopes down on the western side to the terminal station at Manizales. The completed ropeway is only about two miles longer than direct crow-flight between the two towns of Mariquita and Manizales.

The road was completed in 1922, and has given a great impetus to the coffee trade. It is used almost entirely for freight; the journey from Manizales to Mariquita takes about ten hours. Occasionally passengers make the trip, riding on a sort of saddle slung between two carriers suspended from the rope; once a circus, with fifteen tons of animals, journeyed over the rope route. Thanks to this Dorada Ropeway the country in that mountainous district of Colombia is coming into prosperous cultivation.

PART FOUR

EUROPE

1

THROUGH THE SNOWS OF SCANDINAVIA

FAR to the north in Europe engineers have built some of the most remarkable railroads of that continent. These are the lines that cross the Scandinavian peninsula in various directions, roads that do not cover vast stretches of territory, but that have been constructed through snow-bound and hostile country. The most important of these railroads are the Bergen-Christiania, which is confined to Norway, and the Narvik-Riksgrænsen-Kiruna, which traverses territory in both Norway and Sweden. The latter road is the most northerly trunk line in the world, lying as it does in the Arctic Circle, yet it carries a great amount of traffic, due to the fact that it supplies the steel-works of central Europe with iron ore from the vast storehouse of Lapland and Sweden.

In the regions traversed by these roads there are few settlements on account of the length and severity of the winter season; such few hamlets as there are lie near the ore-mines and the forests where lumber is cut for the wood-pulp trade. The seaboard of Nor-

way is a fringe of high mountains and fiords, the interior is a lofty plateau, open to storms from the Arctic, with a tremendous snowfall and very cold weather most of the year.

The mountain barrier of the coast was a great obstacle to the commercial development of this region; a few trading centres, notably Bergen and Trondjhem on the Atlantic Ocean, were fairly prosperous, but their business was much limited owing to their isolation from the flourishing country to the south, and particularly from Christiania, the capital, with which all commerce was by sea.

The inconvenience of the route by water caused a demand for some overland road and in 1811 engineers were sent out on an exploring expedition. They reported such difficulties in the way of building a road through the ranges that the project was given up. Trade was carried on by ships until the Norwegians began to hear accounts of successful railroad construction in other mountainous countries, and agitated for a railroad of their own. In 1870 two engineers again tackled the problem of the ranges, and reported that a railroad could be built, but that the work would be very expensive and difficult.

The enumeration of the difficulties attending the laying of tracks through such a country delayed the start of the enterprise, but in 1875 the government appropriated the money needed to build a transpeninsula rail route from Bergen to Christiania. The road started out from the western coast between

the Hardanger and the Sogne fiords, which wind for more than 100 miles into the high mountains. The engineers had to build almost due south for some six miles and then double back towards Bergen in a great loop of nearly fifteen miles. Another loop took them again towards the south, and the road twisted and turned now this way now that before it reached Vossvangen on the eastern line. Sixty-seven and one half miles of tracks had been laid to cover a distance of less than forty miles by crow-flight.

The road from Bergen to Vossvangen was opened in 1883, and there the rails stopped for a long time.

Vossvangen lies at the foot of a great granite barrier, and as there was no way of flanking the range the engineers must plunge through it. Surveyors hunted for a route through, and decided there was only one point at which a road was possible, at Urhovde Mountain; and a road could only be made here by tunnelling for three miles.

Ten years were spent in making surveys and studies of the range at Vossvangen. Stations were established in the mountains to collect information in regard to snow and wind. As a result it was learned that, if a winter's fall of snow was heavy, the snow would last over into the next winter; also that although the layer of snow frequently did not exceed a few inches on the mountain-tops the snow would drift and pile up into banks of fifteen feet or more in the valleys and protected places. For ten years the government debated whether to go on with the work;

then in 1894 it voted the funds to carry the rails to the summit of Taugevand, 4,250 feet above the sea, and forty-five miles from Vossvangen.

From Vossvangen the climb was made through the Dovrefjeld range by a course along a narrow shelf that was blasted out of the solid cliff to Opset Station, a distance of twenty-eight miles. Here began the Gravehals Tunnel, which burrowed through the mountain for 17,420 feet. From the eastern end of this tunnel the road continued to Myrdalen Station, situated in a great amphitheatre of mountains. Here in the depth of winter the rails and station are not infrequently covered to a depth of thirteen feet or more by snow and the rotary snow-plough is constantly at work to clear the track for trains.

A mile beyond Myrdalen Station the engineers bored another tunnel, the Reinunga; before the railroad was completed from Vossvangen to the summit of Taugevand twelve tunnels in all had been built, of a total length of 11 ¼ miles. Not only was the work itself difficult, but it was hard to obtain laborers in this practically uninhabited, storm-swept and barren land. Yet the rails were lengthening, and in 1898 work was commenced on an eastern section to be built towards the track that was pushing over the mountains. This section also required some tunnels, but the work was easier, on account of the more level country.

In the high country, at Taugevand and beyond in the Bodladal, it was impossible to work in the open

in winter, because of the piercing winds and the snow, and the laborers were used in tunnel-boring. Avalanches frequently swept down on the road and workmen tired of the constant combat with the elements sought less harduous employment in the south. In summer rails were laid and ranges conquered, and presently the road was descending through Gjello and Hol to Aal, and from there through low-lying valleys to Gol. Here, following the Hallingdale River, the track proceeded more easily to Roa, where it joined the main line, which had a comparatively level road into Christiania.

On November 27, 1909, the King of Norway officially opened the railroad of 291 miles that connected the capital of the country with the Atlantic seaport of Bergen and that made it possible to journey from the one city to the other in fourteen hours instead of in fifty-four. It had taken ten years to build the road from Vossvangen to Christiania and the engineers had been obliged to drive 184 tunnels and construct 14 bridges; an immense amount of dynamite had had to be used, for most of the way was blasted out of sheer walls of granite.

Six hundred miles north another railroad was built. Narvik is situated near the head of a peninsula formed by the Beis and the Rombaks fiords emptying into the Ofoten fiord, which washes the eastern shores of the Lofoten Islands, about two degrees within the Arctic Circle. In this wilderness of Lapland there is a mountain, Kiruna, of enormous richness in iron

ore. To develop the Kiruna ironfield a seaport was desired, and it was determined to continue the Great Northern Railway of Sweden from Gellivare through Kiruna and Riksgrænsen on the Norwegian-Swedish frontier to the coast at Narvik.

A group of financiers secured the concession in 1883 to build a railroad from Ofoten fiord to Lulea, at the head of the Baltic Sea, and organized the North of Europe Railway Company, afterwards called the Swedish and Norwegian Railway Company. This concession was later taken over by the governments of the two countries and by them the road was completed. From Narvik to the frontier the line forms part of the Norwegian State Railways system; the eastern section, connecting with the main line to Stockholm, belongs to the Swedish Government.

This most northerly of trunk railroads crosses the wildest and loneliest part of the Scandinavian peninsula, a world of ice and snow. The line is used almost entirely for the transportation of ore and of those who work in the iron-fields. In 1899 the settlement at Kiruna consisted of a few buildings around the shore of a lake, and the only means of communication with Gellivare, 60 miles to the south, was by a rude wagon road or sledge track. The railroad has made Kiruna a busy town, where work in the mines of the mountain goes on night and day for part of the year, since this is the country of the midnight sun. Up and down

the mountain crawl trains of cars as the ore is brought from the summit to the base for transfer to the railroad. Kiruna is situated 1,655 feet above the sea; from there the road runs northwest toward Riksgrænsen on the Norwegian-Swedish frontier through picturesque if desolate country, the mountains, lakes, waterfalls, dense forests and roaring rivers of Lapland. On this section of the road, which is 81 miles in length, only 22 miles is level line. The rails cross the top of the Norwegian mountain backbone, which here, far to the north, is much more jagged than in the latitude where the Bergen railroad was built, owing to the channels made by the melting snow as it rushes down into the great watershed of the peninsula; here much tunnelling had to be done and elaborate defenses constructed against snow-slides.

Riksgrænsen is the junction of the two divisions of the road. It is about 24½ miles from Narvik, but this section to the coast, although less than one-third the length of the Swedish division, was far more difficult to build because of the greater steepness of the western slope of the range. The problem was to obtain a foothold for the grades and then to secure that foothold against the heavy impact of descending avalanches.

Over this Lapland railroad passes an immense traffic because Narvik is an ice-free port open all the year. Much of the line is protected by high snow screens or fences, snow-ploughs battle with the drifts,

and all the locomotives carry a small scoop-plough in place of a cow-catcher. By these means the trains are able to pass back and forth on the rim of the Arctic Circle and to bring the ore from Kiruna to the factories of Europe.

2

IN THE ALPS

WITHIN a comparatively small area Switzerland shows some of the most remarkable triumphs of railroad building, both in surmounting the lofty peaks that are the country's great natural glory and in driving roads through the mountain ranges that would otherwise be a barrier to the flow of traffic between northern and southern Europe.

In the land of the Alps are some of the best known rack railroads, a type of road that is the most economical and frequently the most efficient also where the gradient exceeds 4 feet in 100. The rack is laid between the smooth rails of the track and engages with the teeth of a cog driven by the mechanism of the locomotive. Such roads are those that climb Pilatus, the Rigi, the Wengeralp, and the Jungfrau. These were built for the pleasure of the tourists, and are wonderful examples of railroad mountain-climbing.

Railroads up and down the Alps, however, wonderful as they might be from the standpoint of construction, did not serve the purposes of commerce which was deflected from the little mountain country in favor of more level roads. Switzerland was becoming isolated so far as traffic was concerned as railroads were built to east and west of her. France and Italy completed a line by tunnelling Mont Cenis that brought Paris and Milan within 590 miles of each other, and commerce took to this route. The Swiss republic, lest it should become sidetracked, bestirred itself and outdid the Mont Cenis route by the St. Gothard Tunnel.

The St. Gothard Railroad was completed in 1880, after six years of labor, and reached from Immensee in Switzerland to Chiasso in Italy. There were fifty-six tunnels, with an aggregate length of twenty-five miles. "The locomotive," said a traveller, "scuffles up a steep road for a while, then thoughtfully approaches a mountain that is too hard to climb, and, instead of skipping along the edge and eluding it, plunges boldly into it, makes a complete circuit in a spiral tunnel, and comes out two hundred feet above where it went in. This adroit trick is resorted to seven times, and in one big mountain the locomotive actually accomplishes two circuits of a mile each, rising in corkscrew fashion, and emerging triumphant up where the eagles brood."

The St. Gothard Tunnel itself was the longest tunnel built up to that time, in length nine and one-

fourth miles, and about one and a half miles longer than the tunnel through Mont Cenis.

This new road won back traffic for Switzerland; it also inspired engineers to attempt other railroads through the Alps. The most interesting of the routes considered was one that had been taken by travellers and pilgrims for centuries, a route over which diligences constantly drove, but which presented to the locomotive the barrier of the lofty and massive Simplon. So difficult appeared any attempt to attack this great rampart that it was not until near the end of the nineteenth century that a company—the Jura-Simplon—was organized and received government sanction to proceed with the scheme.

The main feature of the Simplon Railroad was the great tunnel, which eclipsed the St. Gothard. In addition to this there were unique engineering difficulties to be overcome in constructing the approach lines to the two tunnel portals, at Brigue, in Switzerland, and at Iselle, in Italy. The bore was planned to drive through the range between the Rhone and the Diviera Valleys, on a tangent, with curves at each entrance, making the total length 12.3 miles. The tunnel crossed the boundary between Italy and Switzerland, and more than half its length was in Italian territory.

The tunnel, as designed, was to have a width of 14.78 feet at the level of the rails and of 16.4 feet at a height of some 6 feet above the rails, and a maximum height of 18.04 feet. It was to carry a single

track, although provision was made to drive a second bore in case another track was wanted. A smaller parallel shaft was constructed in advance of the main one, narrow gauge tracks were laid in both tunnels and so connected that the trains that brought in tools and materials for the workmen could deposit their loads, take aboard the rock dislodged by the blasting, switch over to the other road and haul the rock clear of the tunnel.

Work was begun on August 13, 1898, and it was estimated that the Simplon Tunnel would be completed in November, 1903. Rapid progress was made at the start, owing to the perfect organization; then the drillers at the northern end encountered an obstacle that almost stopped the work. This obstacle was heat. The engineers expected the temperature to increase as they drove into the mountain, but did not expect it to exceed 95° to 97° Fahrenheit at the fifth mile from the entrance. At the fourth mile, however, the thermometer soared to 113 and 115 degrees. The engineers thought this must be local and pushed the work on with speed. To their astonishment the thermometer went on rising, to 127 degrees beyond the fifth mile. A powerful ventilating plant was installed, but the cool air from this was inadequate, and it was only by bringing water from an icy mountain stream and spraying the tunnel that work in the boring could be done at all.

On the southern side no heat zone was encountered, but one day the blasting opened up a vent for

an underground stream of enormous volume. Torrents of both hot and cold water broke through the fissures made in the rock by the explosives, and rendered that part of the tunnel unworkable.

The engineers were delayed here for a considerable time, but presently they devised a means of carrying the water away as fast as it poured into the workings. Then the men were urged to redouble their efforts so as to get beyond the springs in the mountain and allow the fissures to be closed up.

Yet another difficulty was the grinding of the mountain mass, which caused the strongest wooden beams to splinter and even bent the iron supports. The only way to overcome the movement of the dense rock was found to be by using huge blocks of concrete and the toughest steel that could be made. So extraordinary were these obstacles of temperature, underground streams and pressure of the mountain mass that the work was much delayed and it was not until February 24, 1905, that the last barrier of rock yielded to the blasting and the tunnel was driven through the mighty Simplon.

The Swiss government, adopting the plan of combining all the standard gauge trunk railroads of the country in one national network, took over the completed Jura-Simplon route, and then proceeded to build a second tunnel through the Simplon so that traffic might not be interrupted should it become necessary to repair the tracks. The construction of this second tunnel was almost as herculean a task as the

completion of the first had been, but the work was finally crowned with success when the keystone was set in the arch on December 4, 1921.

The "playground of Europe," as Switzerland is often called, has many other wonderful railroads. One of these is the Bernina road that connects St. Moritz by way of the beautiful valley of the Upper Engadine with the Italian lines at Tirano. This railroad traverses a rugged country of lofty mountain peaks; at one point there are five tracks, side by side though below one another, in a stretch of country about three-quarters of a mile wide, and the tracks are connected by four loops, three of which are in spiral tunnels. The trains on the Bernina road, which is about 38 miles long, are run by electricity, and this line through the Engadine is the most elevated railroad of its type in Europe.

From the Swiss end of the Simplon road swings off the Martigny-Chatelard—Chamonix Railway, which provides connection with Geneva and opens up the Chamonix Valley and the country in the neighborhood of towering Mont Blanc. The scenery along this road is magnificent as the track climbs by rising curves over arched viaducts built against the forest-covered and snow-capped mountains.

3

INTERNATIONAL ROADS

THE first railroad in France, the Paris and St. Germain, was opened in 1837. The tracks covered eleven miles, and the performance of the locomotive was regarded as a prodigious triumph. On the first day, the London *Times* reported, the train "started at twelve, to the instant, and then was the clatter of voices raised tenfold. '*Il part—ce coursier de feu et de fumée!* He snorts! he snorts! His prodigious tail of vapor floats in the firmament! *La voilà!*' Even when the engine had attained its extreme velocity, the rattling of tongues was continued, one person shouting into a second's ear, and a third shrieking at the extreme pitch of his voice. '*Cheval magnifique!* Noble and intrepid horse which nothing can stop! He devours the way before him—he snorts! He is clothed with thunder, like the horse of Job! *Corbleu!* what a delicious motion—*n'est-ce pas? Oui, c'est le plus grand plaisir du monde!*' "

The St. Germain railway was a triumph; short

railroads would be successful; but the government did not think the public needed trunk lines, which would be unprofitable. When the head of the government, M. Thiers, was asked for a charter for a railroad from Paris to Rouen he refused to grant it; "Iron is too dear in France," said the minister of finance; "The surface of the country is too broken," said one deputy; "The tunnels would be injurious to the health of passengers," declared another deputy.

Look at the railroad map of modern Europe. In every direction run trunk lines, with magnificent expresses. Some of the best known trains are the "Calais-Mediterranean Express," the "Pyrenees and Côte d'Argent Express," and the "Sud Express." The "Orient Express" provides through communication between London and Constantinople; there is also the "Simplon Orient Express" which furnishes another through route by way of the famous Swiss and Italian tunnel. This last-named express makes the journey from Paris to the capital of Turkey in about 84 hours, and of this about 15 hours is taken from the actual running time for stops at the various frontiers, where passport and customs regulations are complied with.

The "Sud Express" links Paris with Madrid, a distance of 909 ½ miles, and with Lisbon, 1,187 miles. This train divides at Medina del Campo, 772 miles south of Paris, one section proceeding thence to the capital of Spain and the other to the capital of Portugal; both journeys are made at an average

speed of a little more than 35 miles an hour. The "Rome Express" connects Paris with Rome by way of the Mont Cenis Tunnel, averaging about 31 miles an hour for the distance of 903 miles.

The "Pyrenees and Côte d'Argent Limited" carries passengers from Paris to the mountains between France and Spain and to the Basque seacoast. The "Calais-Mediterranean Express," popularly known as the "Riviera Limited," supplies a luxurious through service for English travellers to the fashionable watering-places in the South of France. A Pullman Limited train runs from London to Dover, where the passengers transfer to a cross-Channel boat; arriving at Calais, the "Riviera Limited" takes them over the tracks of the Nord Railway the 187 miles to Paris at a speed of nearly 46 miles an hour. At Paris the train switches to the tracks of the Paris, Lyons, and Mediterranean Railway, and the journey of 695 miles to Ventimiglia, the French-Italian frontier station on the Riviera, is made in eighteen hours. The entire journey from London to the Mediterranean resorts is accomplished in approximately twenty-four hours. This is a magnificent train, made up of the coaches of the International Sleeping Car and Great European Express Trains Company, which is to Europe what the Pullman Company is to North America. This company has greatly facilitated travel across international frontiers by its dining- and sleeping-cars; it serves all the countries of the continent except those of Scandinavia and Russia,

and even reaches to Algeria, Egypt, and Manchuria. To connect those countries its coaches traverse the tracks of the northern and southern French railroads, the Paris, Lyons, and Mediterranean, the French lines of Alsace and Lorraine, the State railroads of Belgium, Holland, Switzerland, and Italy, the roads of Jugo-Slavia, Rumania, Bulgaria, Czecho-Slovakia, Greece, and Turkey. On each of those divisions the company that owns the line is responsible for the motive power and the movement of the train, but the through coaches are those of the International Company.

Oddly enough, it was in the kingdom of Greece, that was once the centre of learning and the arts, that the railroad lagged more than in any other part of Europe. There was no overland railway communication with Athens until 1916. Prior to that time there were a number of scattered independent roads, most of them narrow gauge; the most important of which was the system that wandered through the peninsula of Peloponnesus for a distance of 472 miles and communicated with the capital of the country.

The great through railroad that linked Paris with Constantinople passed by Greece, but did not connect with Athens. Lack of funds in the Greek treasury and the Balkan wars were largely responsible for this, but a railroad was projected to be built on the standard gauge, to run longitudinally through the peninsula, and to tie up the small independent lines that served various sections of the country. This

road was to start at the port of Piræus in the south and to travel north by way of Athens, Thebes, Livadia, and Larissa to the northern Greek boundary. This railway, as built, was a remarkable triumph of engineering, great viaducts and lengthy tunnels were frequently required, for the tracks had to be carried across many tremendous gorges and plough their way through precipitous mountains.

This Hellenic longitudinal road was of great benefit to Greece commercially, but its traffic was local, since it did not touch the through lines of Europe. To make it financially successful its tracks must be extended through Macedonia, and a contract to do this was made between the Greek government and the Société de Construction des Batignolles in 1914, by the terms of which the railroad was to be continued north from the Pappapouli terminus to Platz on the Monastir-Salonika Railway, a distance of 57½ miles.

This connecting branch follows the high road from Athens through Macedonia, and runs near the shore on the western side of the Gulf of Salonika. It took nearly two years to build, but the cost of construction was more than justified by the great benefits acquired through the junction with the main line that runs through the port of Salonika to Constantinople.

The Hellenic Railway has become an important part of the great European international system. Athens is put into direct communication with Con-

stantinople, Belgrade, Budapest, Vienna, and Paris; the Piræus has become of large strategical and commercial value because it is the European port nearest to Alexandria and the Suez Canal; and other ports, Corinth, Patras and Nauplia, make great use of the steel highway that runs through the Peloponnesus and connects with the rails of the Orient Express.

PART FIVE

ASIA

1
ACROSS SIBERIA

MUCH of Siberia is a great plain, and to build a railroad across it from Moscow in Russia to Vladivostok on the Sea of Japan presented no special engineering difficulties; the chief problem with which the builders had to cope was that of bringing supplies, wood, water, food, and labor from the base to the rail-head. It is said that an Englishman was the first to suggest a trans-Siberian railroad and that Americans were the first to make an offer to the Russian government to construct such a road. However that may be, it was Russia that built the road, and it was Nicholas II, then the Tsarevitch, who laid the first stone of the railway at Vladivostok on May 19, 1891.

The whole road was divided into seven sections and work was carried on practically simultaneously. The first link, from Chelyabinsk to Omsk, 492 miles, was opened for traffic in December, 1895; the second, from Omsk to Ob, 388 miles, in 1896; the third, from Ob to Krasnoyarsk, 476 miles, in the same year; and the fourth, from Krasnoyarsk to Irkutsk, 672 miles, in 1898. At that date tracks had been laid 3,371¼

miles east from Moscow, and also tracks laid from the opposite terminus of Vladivostok 477 miles to Khabarovsk on the River Amur; so that it will be seen that the engineers had worked very expeditiously.

The Siberian Railway is a vast project; it was built by fits and starts, and when a through route was established it was disrupted by the Great War and thrown into the disorganized conditions that pertained to everything in the former Russian Empire. It traverses a very sparsely populated country, much of it a wilderness frozen for a great part of the year, with unsightly villages straggling here and there. It was a great dream of empire; whether it will ever become one of the world's great highways, commercially successful, depends on whether harmony can be restored among the conflicting interests of the peoples of the Ural Mountains, the Lake Baikal district, Mongolia, and Manchuria.

2

THE TRANSCASPIAN ROAD

SOUTH of Siberia the Russian Empire had, in the nineteenth century, penetrated into Central Asia, and desired to link up various points in that turbulent region with strategical railroads. One of the projects was to build from Uzun-Ada to the oasis of Kizil Arvat, a distance of 145 miles. The chief difficulties here were the sandy, shifting nature of the country and the complete lack of water along the route. The railroad was built, of the 5-foot gauge standard in Russia, and became one of the links in the Transcaspian system.

This system starts at Krasnovodsk, on the eastern side of the Caspian Sea, and runs for twenty-five miles to Uzun-Ada. This stretch and its continuation to the Oxus is through the celebrated Kara Kum or Black Sand Desert, a level expanse broken occasionally by oases, where a river or well furnishes water in the sandy waste. From the Oxus to Bokhara the railroad traverses fairly fertile country for

72 miles; then crosses more desert, and reaches Samarkand, located in an oasis. At Chernayevo, 1057 miles from the Caspian Sea, one branch of the road runs north to Tashkend, an important post in Central Asia, and another east to Kokand, Margelan, and Andijan through the luxuriant cotton fields of the Zarafshan Valley.

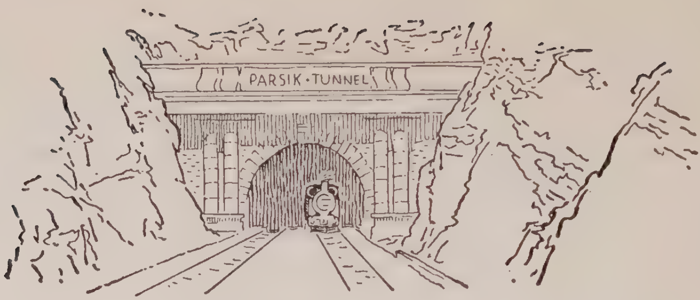
In building this road natives made the embankments and cuttings, Russians spiked down the rails. Lack of water was the chief obstacle; there was no fresh water in the first 110 miles from the Caspian Sea and the sea water was distilled and sent forward along the line in vats carried on trucks. For part of the way the sand, piled in loose dunes and blown about by the strong winds, was as troublesome as the snow in northern regions. Near the Caspian Sea the water was poured on the sand to solidify it, and clay was spread to form a blanket. In other places tamarisks and wild oats were planted on the sand hills to keep the sand from blowing, and the engineers built wooden fences on top of the dunes as snow-sheds are used in the north. The builders were fortunate in the matter of fuel; there was little coal or wood, but there are some of the richest oil-fields in the world in the territory between the Black and the Caspian Seas. Tank steamers carried the oil to Krasnovodsk, and the locomotives of the Transcaspian road were furnished with a special oil-burning apparatus.

The railroad was constructed to Kizil Arvat in 1881, and there the work halted. There was unrest on

the Afghan frontier, however, in 1885, and the Russian government decided to push on into Turkestan and use the railroad for military as well as commercial purposes. In 1886 the rails were laid to the Oxus, across which in former centuries have passed Alexander the Great, Genghis Khan and Tamerlane. Here the engineers drove piles into the mud of the river, 3000 yards wide, built trestles and surmounted them with rails over which ran the locomotives and trains, to the astonishment of the Asiatic spectators.

The Russians avoided Bokhara, not wishing to give offence to its Ameer and fanatical citizens by constructing a railroad to that city. They made a wide loop about that centre, and afterwards joined it to the main road by a branch line.

Samarkand, the ancient capital of Central Asia, saw the first railroad train arrive within its territory in May, 1888. There the railway system marked time for several years, until Russia expanded its military plans and carried the track on to Tashkend, the most populous city in Asiatic Russia. From Tashkend a railroad has been constructed 1000 miles across a barren and sparsely settled region to Orenburg on the Trans-Siberian route. Thus central Asia has been joined to Europe and cities that were isolated for centuries linked together by the Transcaspian Railroad.



3

UP AND DOWN INDIA

IT was under the engineering supervision of Robert Stephenson that the first railroad in India was built by the Great Indian Peninsula Railway Company, chartered to construct a line from Bombay to Kalyan, a distance of 34 miles. The gauge of this road was 5 feet 6 inches, the standard Indian broad gauge. Work was begun in February, 1852. The chief problem was the best method of laying the rails through the Bombay swamps, and this was solved by the expedient adopted by George Stephenson in building across Chat Moss on the Liverpool and Manchester road; mattresses were made from mangrove trees and spread upon the mud; then soil was placed on top to press the mattresses a certain depth; another mattress was superimposed and more soil placed, until a structure was obtained sufficient for a solid roadbed.

The road was opened for traffic in April, 1853, and the builders planned a more comprehensive system. From Kalyan two other roads were to branch; one

to the northeast, the other to the southeast to serve the country around Madras. The obstacle on both these lines was the rampart of the Western Ghauts, where mountains rose almost vertically to a height of 2000 feet.

The driving of a road over these Western Ghauts was the crowning achievement of the engineers of the Great Indian Peninsula Railway. The tracks had to turn and twist in order to take advantage of every possible foothold in the steep mountain slopes. Tunnels bored here and there, embankments and bridges crossed wide chasms, and the rails doubled back in various places so that they might win forward. The most famous bridge was the Ehegaon Viaduct, where the rails crossed 190 feet above the bottom of a gorge, the highest bridge in India. Once over the Ghauts construction was easier, the rails crossed hundreds of miles of sandy plains.

Meanwhile on the eastern side of India a pioneer road was being built out from Calcutta by the East Indian Railway Company. This was a comparatively simple matter of engineering, as the road, following the Ganges River, ran through level country. Several wide bridges had to be built, one across the Hooghly, one across the Sone, others at Allahabad and Delhi. The construction of the Sone bridge was broken in upon by the Indian Mutiny, when the chief engineer and his assistants had to fight the natives until British troops came to their rescue. The damage done to the tracks and stations during the Mutiny

is said to have cost the East Indian Railway Company not less than three million pounds.

The tracks of this company were begun in 1853, and two years later had reached to Raneegunge, 120 miles from Calcutta. From there it had been originally planned to continue to the south of the Ganges, but industrial centres of the river valley wanted railway connection with the great eastern seaport, so the builders laid their rails close to the Ganges, and in 1866 the first train from Calcutta entered Delhi.

India now has about 37,515 miles of railroad, or more than one-half of the total mileage of Asia. The most important terminals are the seaports of Calcutta, Madras, Bombay, and Kurachi, and the inland city of Delhi. Five railroad systems extend from Calcutta; the first runs northeast into Assam; the second north to Darjeeling, in the Himalayas; the third —which is the main line, known as the East Indian Railway—runs through the Ganges Valley by way of Allahabad to Delhi, where connection is made with a railroad travelling northwest to Peshawar, on the frontier of Afghanistan; the fourth runs west to Nagpore; the fifth follows the coast to Madras and in junction with another line opens a route for traffic to the Gulf of Manaar, between India and Ceylon.

On the west coast Bombay is the starting-point for four systems; the Bombay and Baroda, running northeast to Delhi; the Great Indian Peninsula, which takes a course northeast to Busawal, from

where one branch runs to Allahabad and a second to Nagpore; the Bombay-Jaipur, which connects with a road coming from Madras; and a railroad along the west coast to Panjun, a Portuguese seaport.

Madras is joined to Calicut on the opposite coast by a road that runs through Trichinopoli, and by another road with Bangalore. The Indus Valley Railway starts at Kurachi, follows the river to Shikarpore, from where it extends a branch line north to Quetta, in Baluchistan, and continues to Mooltan, which is the junction of roads to Lahore and Jhelam, on the Calcutta-Peshawar main line.

This is the network of railroads in India and they are important roads; that from Calcutta to Peshawar covers about 1600 miles, that from Calcutta to Bombay 1000 miles, and that from Calcutta to Tuticorin 1700 miles.

India was a densely populated country, with rich agricultural regions and a trade that was dependent on rivers and a few highways for transport until railroads were introduced. At first it was said that railroads would not pay, that the natives would not ride on them, that they would be too difficult to build. But the railroad has proved enormously profitable in developing agriculture and trade; the natives like to ride on it instead of travelling on foot or in jolting carts and find it of inestimable help in times of famine; the difficulties of construction have all been overcome by the genius of engineers. These difficulties were not slight; on the western side were the

great steep Ghauts to be surmounted; in many places wide rivers had to be bridged; and in the neighborhood of the rivers were swamps that necessitated the building of many miles of viaducts. In addition there were the jungles, filled with savage beasts and with fever; natives had to be employed because of the tropical heat and it was not easy to train the natives to do the work required. The track-layers worked under difficulties; an English engineer declared that Indian railways should be hung on chains, in order to keep the passengers out of the reach of wild beasts!

In some parts of India political and military considerations have had much to do with the building of railroads. The Indus River flows near the frontier of Baluchistan, and the railroad runs northeast through the river valley from Kurachi, on the west coast, to Shikarpore; there the branch on the left reaches 133¼ miles north through Baluchistan to Sibi; this branch was built in four months in 1879, when political difficulties arose on the Baluchistan frontier, and was a remarkable achievement, the railroad being constructed under the handicap of a lack of food, water, fuel, and shelter for the workers.

The Sibi Railway is notable. From Sibi the tracks run in two separate curves to Bostan Junction on the Bolan Pass, a distance of 112 miles, and climb to an altitude nearly 6000 feet higher than that at Sibi. One loop takes in Quetta, and on this line the general gradient is 1 in 67. To build these loops 30,000 men

The Modern Railroad Gives Access to the Splendors of Ancient Asia

were employed on tunnels, embankments, bridges, and viaducts, and the work was done in feverbreeding heat and heavy rains, as trying to the natives as to the whites. The mountain passes through which the road wound are as high as those in the North American Rockies and the tracks turn and bend as frequently as do those of the Alpine country. From Bostan the railroad reaches on to Kandahar through the Khojak Tunnel, 2½ miles long. The Sibi Railway thus protects the frontier of Afghanistan and makes Quetta in Baluchistan an invaluable stronghold for defense.

The railroad that climbs through the Himalayas from Silliguri to Darjeeling was built to supply the need of the tea-plantations for a rail-route to Calcutta and also to enable the English residents of India to escape from the heat of the low lands to the cool heights of the mountains. Silliguri, which is 250 miles from Calcutta, is the junction-point of the broad gauge East Indian Railway line and the 2-foot track that climbs 7500 feet in covering 50 miles of country. Here travellers to Darjeeling take small cars of light weight for the ascent, where the gradient in some places is 1 in 23. This is a remarkable climb, along a course that winds as sinuously as the track of a snake; the train crawls along narrow ledges; the motive power of the train is transferred from one end to the other as it zigzags upwards, so that the passengers are sometimes riding backwards, sometimes forwards; different engines pull the train

over each zigzag and sometimes two push or pull. The heat of the low country drops away, the air grows cooler, the slopes are covered with snow, another curve is rounded, and the train runs into Darjeeling, called the "Queen of the Himalayas"; a little more than a hundred miles away rises the peak of Mount Everest, the highest mountain in the world.

One other Indian railroad deserves mention, that which climbs through the Nilgiri Hills. This line starts at Mettapollium, a station of the Madras Railway in southern India, and ascends nearly 5000 feet to the plateau on the Nilgiri Hills, on which are located the towns of Ootacamund, the summer headquarters of the Madras government, Coonoor, and Kotageri, the residences of planters and English officials. The railway is 16¾ miles long, of which 12 miles are worked on the rack principle. The line has 23 large and 113 small bridges, some of them 120 feet high. In one place the road passes for 1000 feet along the face of an almost vertical cliff 2000 feet high; in another place it crosses a bridge 150 feet long and immediately enters a tunnel that runs for 275 feet on the face of the cliff. To prevent landslips the slopes were planted with Guinea grass, which holds the earth together more securely than any other artificial device, and along parts of the cliffs great retaining walls were built. The line cost about £15,000 per mile to construct, but the expense has more than justified itself in simplifying communication between Madras and the plateau of the Nilgiri Hills.

PART SIX

AFRICA

1

AFRICA

AFRICA is a continent of great contrasts, inhabited by people widely dissimilar; within its borders are deserts, jungles, vast rivers, extensive veldts or high plains, extraordinary agricultural and mineral wealth, a storehouse of riches of every description.

Look at the map of Africa. Along the north of the continent on the Mediterranean Sea lie what were in former times known as the Barbary States, the home of the Moors, the countries of Morocco, Algeria, Tunis, and Tripoli or Libia. East of Libia is Egypt, with the Mediterranean Sea on its north and the Red Sea on its east, the two connected by the Suez Canal. South of Morocco and Algeria is the great Sahara Desert, and this is bordered along the Atlantic Ocean by many countries, inhabited by negroes or various tribes of Moorish race, most of the countries belonging politically to European nations. In Libia and Egypt is the Libyan Desert; from the north of Egypt, above Cairo, the mighty Nile River

flows to the south, and the main stream and its tributaries make fertile a great land that but for the Nile would be an arid tract. This north central part of the continent, embracing the two large deserts, is known as the Sudan.

South of the Sudan, in equatorial Africa, is a great, only partially explored region, inhabited by many tribes, and divided politically into many countries, Abyssinia, Somaliland, the Belgian Congo, Uganda, the Tanganyika Territory. On the equator lies the great lake of Victoria Nyanza. Still farther south are Rhodesia, the Bechuanaland Protectorate, and the Union of South Africa, that forms an important part of the British Empire. This southern section of Africa possesses great riches, among other things great diamond mines, and is altogether different, in topography, people, climate, and natural resources from the Moorish Mediterranean countries, the Sudan, or the Congo.

It can readily be seen that a continent of such great differences, much of it almost unmapped, inhabited by so many tribes, with few large settlements, and divided among so many owners, would not be one to tempt railroad-exploiters. Railroads require traffic, and traffic in Africa is largely localized. African railroads unite near-by points of commercial importance, but do not wander through forests and jungles. That is the reason why the great dream of a Cape to Cairo railroad, running the length of the continent from the Cape of Good Hope to the Medi-

terranean Sea, has been so difficult to achieve; it would have to traverse regions commercially unprofitable, and the traffic necessary to support a railroad does not travel north and south so much as east and west from the interior to the seaboard.

The story of African railroads is necessarily disjointed. In some parts of the country not only the deserts and forests but the native tribes have been the obstacles to roads. The incentive to the builders has been the desire to make profit from the great natural riches of the interior. The French long wanted to construct a track across the Sahara for the double purpose of subjugating hostile tribes and of opening a trade route between their possessions in Algeria and those on the Congo and Niger Rivers. With this object they sent out a surveying expedition in 1880 to explore the desert. The party reported on a favorable route, and the next year another band of surveyors attempted the desert and penetrated 800 miles through the Sahara to Tadjenoût, an oasis in the Ghat region. Meanwhile the tribe of the Tawareks and their neighbors the Shaambah Arabs, deciding that a railroad would hamper their freedom as bandits, plotted against the invaders. The Shaambah guides betrayed their French employers and the Tawareks wiped out the surveying party. More than one such incident showed that the nomads of the desert did not take kindly to rails and locomotives.

The explorer, Henry M. Stanley, reported that the region of the Congo River had vast possibilities of

exploitation but that to get at the wealth of that vast country required railroads. A small steamer was used on the river in 1881, but this was little aid to commerce; the trails to the river were almost impassable, merchandise moving in and out of the forests could only be carried on the heads and backs of negroes, and ivory was the only product that could profitably be transported in this way.

To open up the Congo country a Belgian officer, Albert Thys, founded the Congo Commercial and Industrial Company in 1887, and this company finally completed the Congo Railroad from Matadi to Leopoldville. This road, of some 250 miles, was completed in 1898, and its construction called for the greatest ingenuity in engineering, over mountains, through swamps, and in a country where the climate was exceedingly hostile to the railway builders. The Congo Railroad has great commercial possibilities. It penetrates one of the richest mineral territories in the world, steamers ply on the rivers as far as Stanley Falls, 960 miles east of Leopoldville, and all this river commerce of the Upper Congo country utilizes the railroad for its journey to the coast.

In the southern section of Africa there were fewer natural obstacles to the construction of railroads than in the northern and central parts. There were no wild nomadic tribes, the climate was more healthful, the distances from settlement to settlement not so great. The first line that was built in Cape Colony

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Bridge Over the Zambezi at Victoria Falls

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Clearing the Tracks in Switzerland

was begun in 1859 by the Cape Town and Wellington Railway and Dock Company; it was about 55 miles in length and reached from Cape Town to Wellington. After its completion another road was built from Cape Town to Wynberg, and in 1871 these two railroads were taken over by the Cape government which had decided to nationalize the railways of the country.

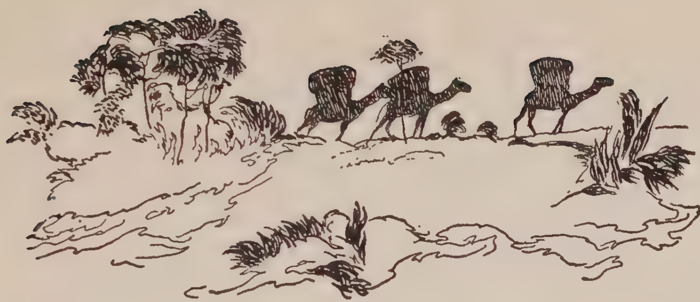
There was a considerable divergence in gauges in the South African roads. Egypt is the only section of the continent where the Stephenson gauge is the standard. The Cape roads used a narrower gauge, and the gauge adopted by a commission appointed to study the subject was 3 feet 6 inches. This is now practically uniform throughout the Union of South Africa, and the railroad into Natal and the road Cecil Rhodes constructed through Rhodesia have been changed to conform to it. Lines that are built to different gauges are the Uganda Railway, where 585 miles of track are constructed on the Indian metre gauge, the roads of Sierra Leone, where the gauge is 2 feet 6 inches, and the railway in what was formerly German Southwest Africa, the Otavi line, which is the longest 2 feet railroad in the world.

South Africa has some famous express trains. The chief of these are the "Union Limited" which runs from Johannesburg to Cape Town, and the "Union Express" which makes the journey in the opposite direction. These trains, which connect the com-

mercial and industrial section of the country known as the Rand with the capital of the Union, are first-class in every respect. At Kimberley, the "diamond city," connection is made with the "Cape-Natal Express" and "Cape-Natal Limited" that run between Durban and Cape Town.

PART SEVEN

THE FAR EAST
AND
AUSTRALIA



1

THE FAR EAST AND AUSTRALIA

WHEN Commodore Perry of the United States Navy made his famous treaty with the rulers of Japan in 1854 it is said that among the wonders of western invention displayed by the American sailors to the admiring Japanese was the model of a steam locomotive that ran on rails. It was not until some time later, however, that the people of the country became acquainted with the steam railroad that was revolutionizing commerce and travel in other lands, not until Japan threw off the yoke of the autocratic caste that had been dominating the nation for centuries and won a representative form of government. Then the country became receptive to the new ideas of western civilization, among which the railroad was one of the foremost. In 1869 an Englishman named Lay told the British minister to Japan that he would like to introduce the locomotive into Nippon and arrange for the capital and materials needed to build a road.

The British minister reported this to the Imperial government and Count Okuma and Prince Ito, two high officers of state, were so much impressed by the offer that they obtained the requisite approval. Lay was authorized to raise a loan of £100,000 in London, to engage engineers, and buy material for a railroad to be constructed over the eighteen miles between Tokio and Yokohama.

Lay, returning to England, engaged as chief engineer Mr. Morell, who went to Japan the following spring to survey the route for the line. While he was engaged in this the Japanese officials objected to some of the methods that were being used by Lay in obtaining the funds, dissolved the contract with him and appointed the Oriental Bank to raise the money and supervise the road. Morell, however, was retained as chief engineer, and he was the builder of the first tracks of the Japanese Imperial Railway system.

The construction of the railroad from Tokio to Yokohama was followed the next year by the building of a second road from Kobe to Osaka, a distance of about twenty miles. The completion of the first line was celebrated magnificently on October 14, 1872. The Mikado, the princes of the blood, the nobility, the Diplomatic Corps, and many invited guests, all arrayed in ceremonial costume, moved under arches of azaleas and chrysanthemums to the railroad station, and there, before an assemblage of twenty thousand spectators, boarded the waiting

train. The Mikado declared the first Japanese railroad open for use, and the train moved off to the music of the national hymn of Japan. That first road was a great success, the people of the country became ardent travellers by the steam-trains, and soon railways were constructed between all the populous settlements of the Mikado's land.

The first railroad in China was built by an English firm to cover a few miles of country between Shanghai and Woosung. The builders found it very difficult to buy land for a right of way, as the Chinese owners of the district thought the railroad would greatly lessen the value of their property as well as incommode the spirits of the earth and air. A little engine drew the first train on February 14, 1876, and almost at once the line was beseiged with traffic. It worked at a profit for a year; then the Chinese government bought out the company and sent the rolling stock to Formosa as a present to the Governor, Ting Futai, who had expressed a great desire to possess a railroad. No engineers were sent with the rolling stock, however, and as it was damaged in landing Ting Futai found he could make no use of it, having neither workmen who knew how to repair it nor how to run it if it were repaired.

The government of China did not take kindly to any of the first railroads, and the foreign builders had to content themselves with building "toy" lines, with small locomotives and coaches and a narrow gauge track. But these toys proved useful, and pres-

ently were superseded by regular Western railroads built on the standard Stephenson gauge. Backward at first, China became a great railroad-building country.

The Malay Peninsula stretches south between the Indian Ocean and the China Sea, and for centuries rivalled the Barbary Coast as the resort of pirates. In the nineteenth century the English gained a foothold in that wild and lawless region, establishing their influence at Malacca and Georgetown on the western coast and at Singapore, the extreme tip of the peninsula. It was slow work to pacify the native tribes and persuade the half-barbaric rulers to try some of the benefits of Western civilization, but the English persisted, and finally succeeded in uniting the separate states in what is known as the Federated Malay States with a program for upbuilding the peninsula as a whole. This program included the building of a longitudinal railroad through the country, with branch lines to the coasts as trade required.

The country presented many unique problems to the engineers. A thick jungle covered much of it, crossed by many rows of hills and mountains, between which rivers wound their way east and west. The natives had always used these streams for travel, and there were practically no roads, the trails through the forests being the simplest sort of bridlepaths. Vegetation flourished, owing to the heavy rainfall; but the water dripping from the trees and

the rank, moist verdure combined to make the country like a saturated sponge, and jungle, forest and swamp reeked with fever. In addition, the food of the natives was not suited to the requirements of white men, and almost all the materials for the railroad had to be imported from England, which involved a journey by sea of more than 8,000 miles. Before rails could be laid roads had to be made through the swampy woods and jungles and these roads had to be corduroyed before the lightest vehicles could move over the soggy ground.

English surveyors studied the problem where to construct the first line through such an uninviting country, and chose Port Weld, on the western coast, as the point from which to start. A road here would benefit the tin mines, and a railway was built inland eight miles to Taiping and opened for traffic in 1885.

The next year a road was completed farther south, in the state of Selangor, covering 21½ miles from Klang on the coast to Kuala Lumpur inland, also to serve the tin mines. Other branch lines were constructed, and by 1901 there were 244 miles of track in use in the Malay Peninsula. The links of road were knit together and in 1903 continuous communication was established between Penang in the north and Seremban in Negri Sembilan. His Highness the Sultan of Perak rode on the first passenger train of this through road.

When the first section of the longitudinal trans-peninsula line was finished the engineers went to

work on a road to connect the upcountry system with the important commercial port of Singapore. This involved construction through the thickest jungles and over a ground that was soaked with water after every rainfall. The great number of rivers necessitated the building of many bridges and the hauling of supplies long distances from the seaboard. Starting in 1903, the builders carried the tracks from Seremban to the Malacca state boundary at Tampin, where junction was made with a branch road to the port of Malacca. By the end of 1921 the Federated Malay States had 1,020 miles of track open for use. The roads were built on the metre gauge, which corresponds with the gauge of the Siamese railways, and therefore allows free intercommunication.

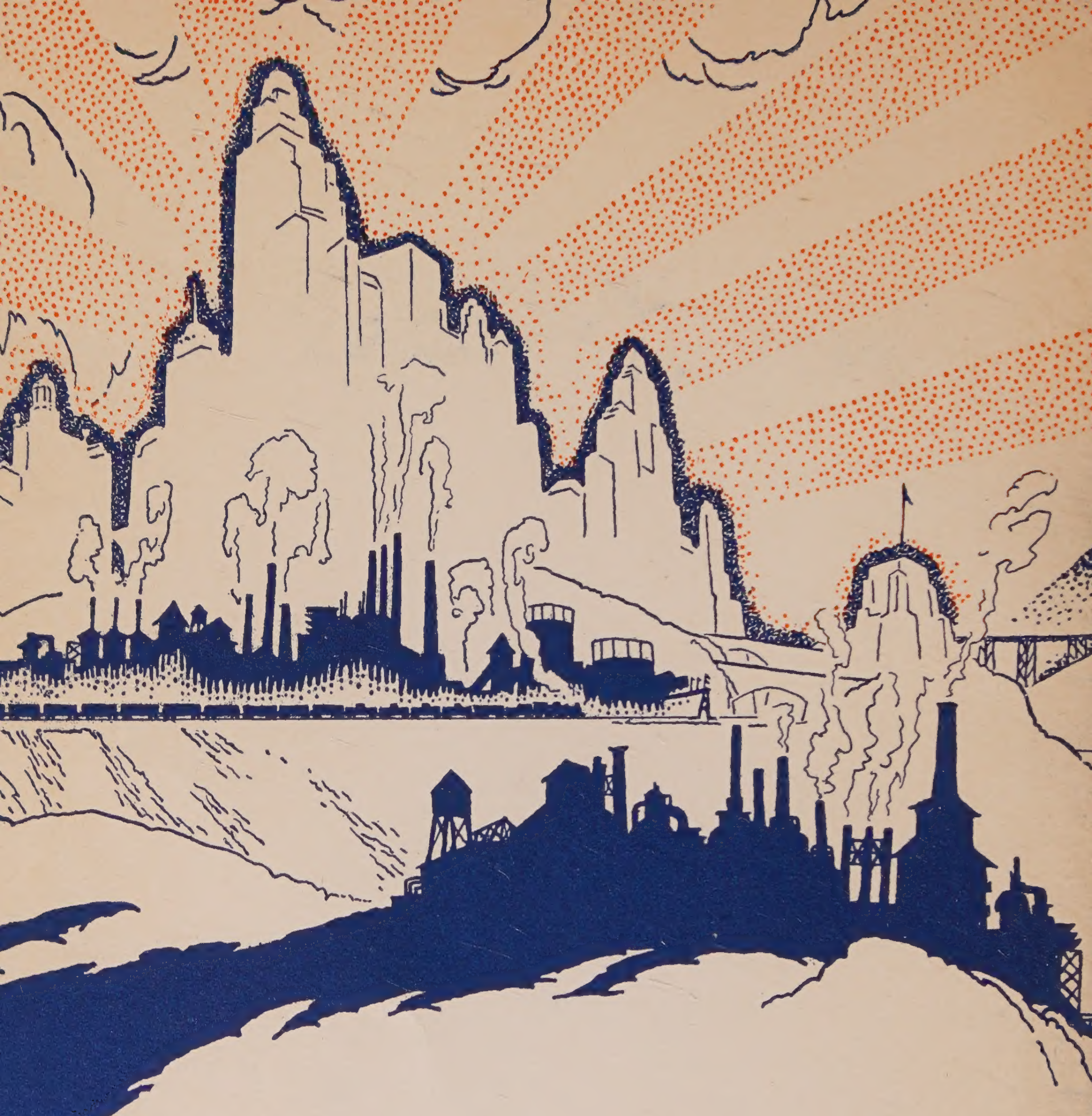
Excellent train service is supplied between Kuala Lumpur and Johore Bharu, the station for Singapore, with the most modern rolling-stock, dining- and sleeping-cars. In 1923 the railroads of the Malay States and those of Siam inaugurated a weekly train between Penang and Bangkok, with connection at Penang for Singapore. By this train passengers are enabled to reach the capital of Siam by a journey of 60 hours from Singapore and of 34 hours from Penang.

Australia is banded by railroads. These are divided into sections, each of which is controlled by a separate state of the Commonwealth. In addition there is a transcontinental road run by the Dominion government. Queensland has "limited" expresses

between Brisbane and Wallangarra, on the border of New South Wales; and between Brisbane and Townsville. From the Central Station at Sydney, in New South Wales,—the largest railroad terminal in the Southern Hemisphere,—many expresses run, the chief of which are the interstate trains known as the "Brisbane Limited" and the "Melbourne Limited." The important expresses of Victoria are also interstate trains, the "Sydney Limited," the "Adelaide Express," and the "Transcontinental Limited." South Australia has the "Broken Hill Express" which runs up country from Adelaide, and another road into the interior station at Oodnadatta. In Western Australia there is the "Kalgoorlie Limited," and also the "Albany Express," from Albany to Perth. On the island of Tasmania the main railroad service is the express from Launceston to Hobart.

The Australian Transcontinental runs from Port Augusta to Kalgoorlie three times a week in each direction, and makes connection with the mail steamships at Fremantle, the principal port of West Australia. This road, and the great network of branches that extend in all directions, have been of the greatest service in welding the widely-separated states of Australia into an harmonious union.

THE END



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